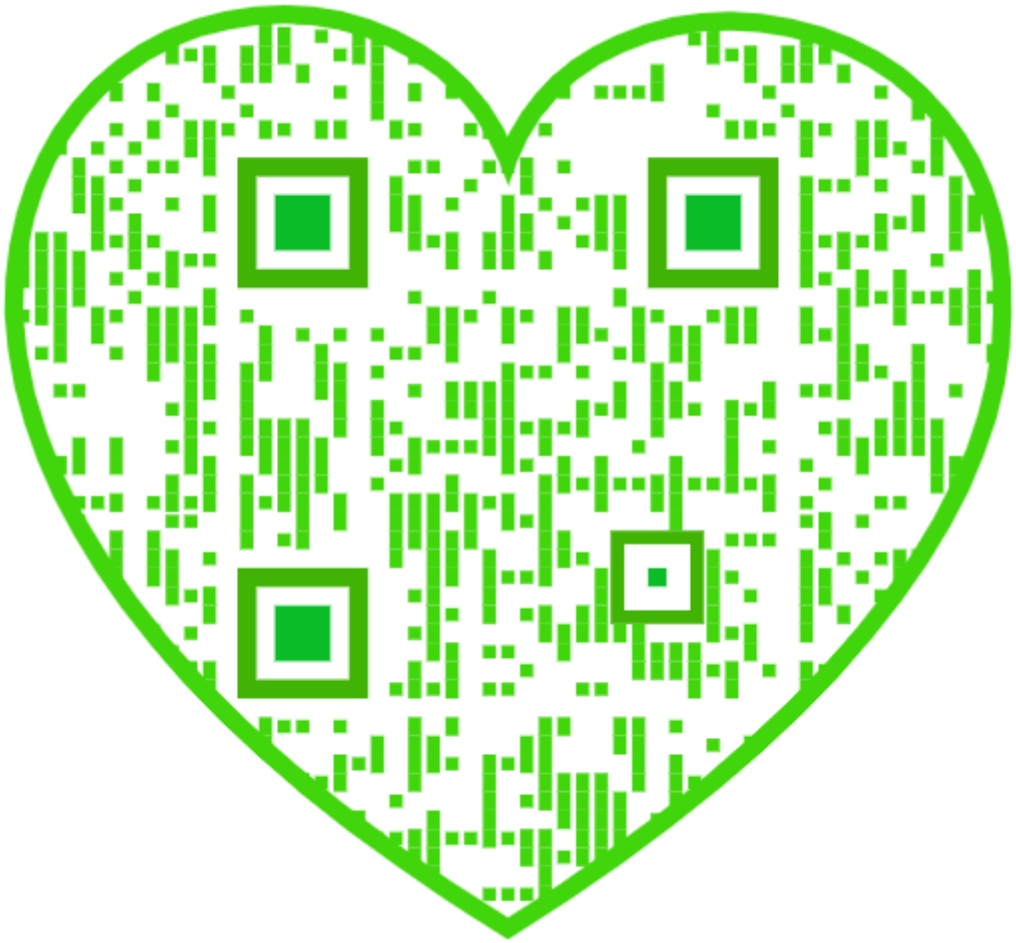

SPECTACLES;

AND

HOW TO CHOOSE THEM.

AN ELEMENTARY MONOGRAPH.

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PREFACE.

The aim of this little work is so plain as scarcely to need an explanation.

It is the intention to make clear, by an agreeable compound of medical and common terms, the uses and modes of fitting Spectacles. Such intercurrent facts only as may serve to elucidate these subjects will be incorporated. The medical treatment, often so essentially accompanying the correction of diseases due to the anomalies of refraction and accommodation, forms no part of the scope of the work.

The attempt to render the whole as entertaining as possible, must be an apology for a certain lack of connection apparent throughout the book. A too close adherence to any one topic would render the subject somewhat tedious, and while undoubtedly scientific, might induce the less ardent student to throw away in the beginning that which, when led on by easy stages, he would gladly read to the end.

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The illustrations are carefully selected to elucidate the letter-press, and although some of the cuts are seemingly large, it is deemed best to give, as far as possible, the actual size of the glasses worn. It is believed that this will materially aid in their selection. Whenever desired, Messrs. Meyrowitz Bros., 297 Fourth Avenue, New York, will supply by mail or otherwise, all varieties of Spectacles mentioned herein.

My assistant, C. F. Barker, M. D., has my grateful thanks for relieving me of much labor necessarily attendant on the passage of the volume through the press.

CHICAGO, FEBRUARY, 1881.

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SPECTACLES;

AND HOW TO CHOOSE THEM.

INTRODUCTION.

The first knowledge of the use of Spectacles is generally attributed to Roger Bacon. It was probably to compensate for the deficiencies of old-sight (presbyopia) that they were first used, for it is said that he pointed out the benefit to old men and "to those that have weak eyes," of viewing letters through a plano-convex lens. But whether he did or not, it seems certain that they were known and used about the time of his death (1292).

To a monk of Pisa, however, who died in 1313, Alessandro di Spina, is sometimes accredited the giving to the public of the use of Spectacles. It is said he saw a pair of lenses in use which were made by some person who was unwilling to disclose the secret of their manufacture. He obtained a pair for himself, and finding

them very useful, cheerfully made the invention public.

For many years after this discovery, no special advancement was made, and the use of Spectacles remained confined to supplying the deficiencies of the eye consequent on age. During the past half century, however, and especially during the last quarter, the subject has been carefully studied by men eminent in the known sciences. That use which was based on a simple accidental discovery, has been supplanted by one controlled by unvarying laws solved by the higher mathematics. Opinions based on the knowledge of past years should be discarded. No age is now necessarily implied by their use. They may be worn by anyone at some period of life, for one or more of the many affections to which they give relief.

These researches have also shown that a large class of troubles, hitherto numbered among the incurable, are readily amenable to treatment by Spectacles alone; and diseases formerly allowed to go on for the want of a remedy, are now by their use promptly arrested. Many who are totally unconscious that their sight is defective, are made to see in a manner never deemed possible. Many who have been obliged to abandon occupations on account of supposed failing sight, can now return to them. Indeed, most of those troubles popularly known as cross-eye, scrofulous affections of

the lids, paralysis of the eyes, and similar diseases, can be cured by the proper adaptation of Spectacles.

It was but recently that the inheritance of an optical defect was one of the most unfortunate of hereditary calamities. This thorough study of the laws governing the use of Spectacles, however, has wrought one of the pleasantest, as well as one of the most remarkable, of changes. By it, members of the same family may be placed upon widely differing planes of life; for occupations closed to the older members by reason of such inheritance, are open to the younger. Inability to use the eyes for near work from inherited defects, has, in nearly all cases, become a thing of the past.

Furthermore, it is clearly demonstrated that it is as useless to expect to do away with Spectacles for eyes impaired by the natural changes of age, as it is foolish to attempt it. Not all eyes require Spectacles for advancing age. Isolated cases seen by those not familiar with known optical laws, and cited as proofs of the error of these assertions, avail nothing. Simple explanations often overthrow seeming miracles.

The changes wrought by age rendering Spectacles a necessity to most, are entirely physiological. No person with normal eyes in youth can escape them; for the eyes of those who do not require their aid from these changes, were not normal in youth, and their

possessors lost a portion of those things seen by others. The correct use of Spectacles as their values are now known, would have revealed much that was lost to them. There is no absolute standard of vision; it is but relative.

The value of Spectacles to every one at some period of life, and their absolute necessity to many at all times, should do away with all prejudices against their use, and lead to its study. Such study will not only remove erroneous notions, but by awakening interest in newly-discovered optical laws, stop the impositions of prowling pretenders. The optician's trade is no part of the oculist's profession, but the optician bears the same relation to the ophthalmic surgeon as does the manufacturer and seller of deformity apparatus to the general surgeon, or the druggist to the physician.

Physicians of skill do not give prescriptions unsought. A like self-respect, and the customs of society, debar oculists of reputation and professional eminence from proffering advice, though it frequently happens that they see improperly adapted Spectacles. Neither does professional etiquette admit of their soliciting patronage, much less of haranguing strangers with the impudence of a triple-tongued marauder.

CHAPTER I.

THE USES OF SPECTACLES; THEIR VALUE; POPULAR NOTIONS; COLORED GLASSES; DIFFERENCE BETWEEN FOCAL AND NON-FOCAL GLASSES; IMPORTANCE OF AN INTELLIGENT DISCRIMINATION BETWEEN THEM.

From early childhood nearly all have been familiar with the fact that Spectacles, or lenses as the oculists call them, have been worn as aids to sight; but nearly all grow up with somewhat confused notions regarding their functions. Indeed, it will not be far out of the way to say that a large proportion know almost nothing of their uses beyond that they help the aged and the short-sighted. So strong have these notions become implanted, that it is not infrequent to find employers declining to engage an applicant wearing glasses; or those needing them going without them, because of a silly (and generally incorrect) idea that they impart a tinge of age or foolishness.

In the hands of a skillful ophthalmologist there is no one remedy at this day, which will, in their various combinations, correct so many troubles and restore good sight, as suitable lenses.

Four great causes for the use of lenses are found in

the defects of refraction and accommodation. They are known as follows:

1. Popularly as short-sight, or technically as myopia, hypometropia, or brachymetropia; being that condition where the focus of parallel rays of light is situated anterior to the retina.

2. Oversight, or hypermetropia, that condition where the focus of parallel rays of light is situated posterior to the retina.

3. Old-sight, long-sight, or presbyopia, that condition where there is a deficiency in the powers of accommodation, and possibly also in the refraction.

4. Irregular sight, or astigmatism, a condition due to a lack of symmetry between the different meridians of the refracting surfaces.

Other causes are found in:

5. The common weak-sight, or asthenopia.

6. Double sight, (diplopia), or where the visual lines of the eyes are not directed to the same point of an object; and

7. A vast class where various non-focal colored glasses are required.

To overcome myopia, concave spherical lenses are used, because they render parallel rays of light sufficiently divergent to impinge sharply on the retina; to overcome hypermetropia, convex spherical lenses are

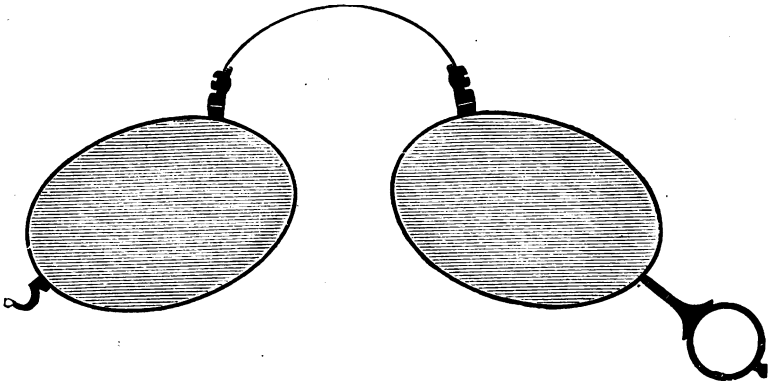


FIG I.

Very light steel frames, with no nose-rests, the rim of steel holding the lens on either side pressing directly against the nose. Preferred by those objecting to much weight of frame.

used because they produce the opposite effect optically; presbyopia is corrected by convex spherical lenses because they supply the deficiencies of accommodation and refraction; astigmatism is corrected by concave or convex cylindrical glasses, with or without a combination with the other kinds as may be indicated, by restoring the symmetry of the different meridians of the refracting surfaces; asthenopia, or weak-sight, by a suitable adjustment of the required kind or kinds hitherto mentioned; and double-sight by another kind known as prismatic lenses.

Were a pause made here and these troubles alone considered as in the majority cured, the great value of lenses would be seen. But when it is understood that many diseases, unsightly and dangerous to vision, as well as vast numbers of lesser ones, caused by these errors in refraction and accommodation, are cured by the relief afforded by lenses to these errors, there opens a far larger field for their usefulness. Myopia alone is a study for months; combined with hypermetropia, in their far-reaching effects and anomalous conditions, it can be made the special study of any oculist, and with difficulty comprehended in the short time usually allotted, by many, to the supposed mastery of the whole specialty. Astigmatism, though seemingly the most difficult, is by

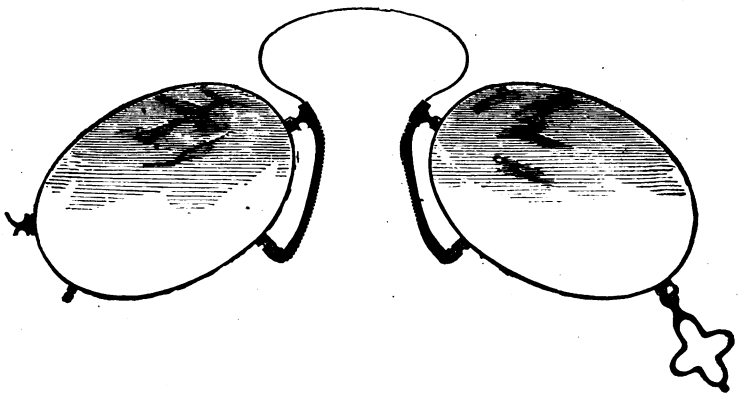


FIG II.

Light steel frames, with supports rendering them suitable for persons wide between the eyes. Much worn and justly entitled to their popularity.

far the easiest of these three anomalies to understand, so far as they at present are known.

Hand-in-hand with the old notions regarding Spectacles, as part of the common ignorance concerning their uses, has gone the idea that all persons can choose their own glasses. Many persons who evince a decided repugnance to wearing ill-fitting ready-made clothing, without thought or in confirmation of profound conceit, select their own glasses without an apparent idea of the incongruity or danger of thus treating an organ whose mechanism is of the most delicate nature, and whose use to most is as valuable as life itself. It must not be inferred that I think nearly all seriously suffer by such a course, but that a large number do, there is no doubt. To avoid risk it is far better in all cases to consult an oculist; in cases where trouble in their use is experienced, it should never be omitted. While preparing these pages for the press, a lady has consulted me whose selection of glasses for a rapidly advancing old-sight, has in her own language "quickly hastened, but in ignorance," a disease (*glaucoma absolutum*), which has rendered her hopelessly blind.

In that large class where colored glasses are required, great care should be exercised in selecting those which certainly have no focus. Blue coquilles are much worn, but in all troubles of the delicate internal parts

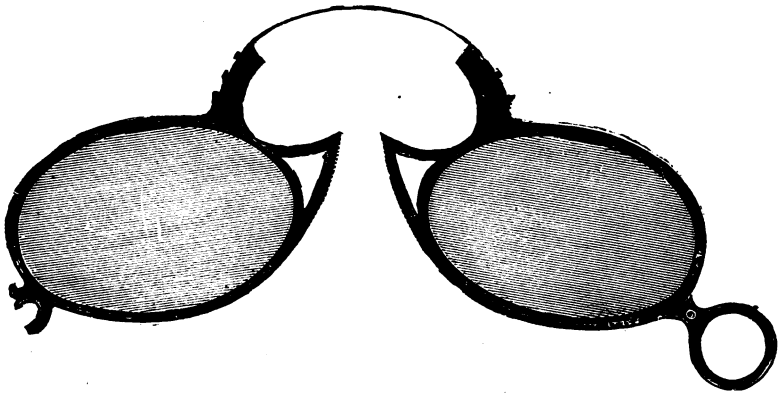


FIG. III.

A plain style of hard-rubber frames, much worn on account of their easy adaptation to those persons who are wide between the eyes, with thin, sharp noses. They are light, but somewhat clumsy.

of the globe, are injurious unless positively without focus. Plain glass, or that without focus, does not distort or dim the objects seen through it. Non-focal glass may be recognized by holding it up to the light and noting if any perpendicular line move with the glass when it is slowly moved from right to left, or the reverse. If it does, or move in an opposite direction, or if images are distorted, the glass is not a safe one to wear. The common cheap coquilles, and by these are meant the common curved blue glasses so generally worn in the country (but not what are known as goggles, which never should be habitually worn in eye disease, and not at all unless by direct order of some oculist,) are made of pressed or molded glass, and it is quite rare to find such without focus, nearly all presenting a negative meniscus. This defect can be obviated, however, by purchasing a pair of glasses of this shape which have been correctly ground, not molded. The effect of such glasses when imperfectly made, is to render the eye hypermetropic, (oversighted) and still farther endanger an increase of the disease by adding another cause of irritation. The reasons for this are given in Chapter XII.

The colors proper for these glasses, and their correct adaption to the various diseases, will be considered in another chapter; but the caution here given cannot be too often placed before the eye of the reader; for it is

extremely rare to find anyone who has any suspicion that such glasses are in any manner injurious to the eye or sight. It is not at all uncommon, however, to find cases where the deeper portions of the eye are kept in a state of chronic irritation from their use, by which other parts of the eye, from what is known as reflex action, are often sympathetically injured.

CHAPTER II.

LENSES; THEIR SHAPE, AND THE MATERIAL FROM WHICH THEY ARE MADE; THE PREVALENCE OF THE TRAVELING IMPOSTOR; THE METHOD OF DISTINGUISHING BETWEEN THE DIFFERENT MATERIALS USED IN THE MANUFACTURE OF GLASSES.

When a person enters a store for the purpose of selecting a pair of glasses, as many are obliged to do, there being no oculist or other competent person in the place to assist in the selection, he will in many cases be asked whether he will have the periscopic or double lenses? This will be the first time many have ever heard the question, and unless it has been previously considered, no intelligent answer can be given.

The ordinary double-convex or double-concave lenses are alike on both sides, the convex lenses being convex on both sides, the concave lenses concave on both sides. Periscopic lenses are concave on one side and convex on the other, the concavo-convex having a shorter radius of the convex surface; the convexo-concave a longer. Could it be done, all lenses would be put into the eye, so that they would really become an integral part of the eye-globe. Such not being possible, they are placed directly in front of the eye. Unfortunately

FIG. IV.

Heavy gold-framed lenses. Much worn by elderly ladies, but not usually with great comfort, on account of their weight tending to make them fall off or tip down. Touching the nose but lightly, as they do, also adds to this defect.

they cannot move with the eye, and hence when the axis of vision, owing to the turning of the eyes, is no longer directly in front through the centres, as is often the case, they prevent free vision in a greater or less degree, according as they are stronger or weaker in power. To overcome this trouble, one must turn his head rather than his eye. With periscopic lenses, less of this trouble is noticed, for there is a freer range of the eye behind the glass, thus permitting a clearer view of objects lying in an oblique field of vision.

Our great authority on these subjects, Donders, of Utrecht, who has done for the sight what Edison has for the voice, says "We can also see satisfactorily in an oblique direction through bi-convex and bi-concave glasses, provided they are not too strong; and if high powers are required, the periscopic have again the disadvantage of greater weight. Were it only for this reason, the latter do not unconditionally deserve the preference. When we add that, under some circumstances, the periscopic glasses are more liable to produce disturbance by reflection on the concave surface turned towards the eye, and that they are, moreover, somewhat more expensive," it can be seen that they have disadvantages rendering it quite an open question among oculists as to which kind has the greater number of points of merit. Without going into reasons

at length, I favor the bi-convex and bi-concave for the most general use. I order each, however, at times, according to special cases.

The question of material for the composition of the lenses must be decided by the use to which the glasses are to be put. Whole country districts, as well as cities, are now and then agitated by the arrival of some "distinguished Russian" (from New York?) or "celebrated Pole" (from Chicago?) who has brought, unfriended and alone, at the sacrifice of health and happiness, but actuated solely by the love of his fellowmen, a peculiar and hitherto unknown kind of "pebble," from which in consideration of the aforesaid love and some ten to twenty times the usual commercial price for the same article, he is willing to sacrifice a few pairs, positively the last he has, to as many dear friends as he can find before leaving for the next town, (there to repeat the swindle, etc.) Probably this state of affairs will long continue, and cannot be arrested by the ordinary dissemination of knowledge. But it might save much vexation of spirit and some money, were it generally known that all lenses are made from two materials, glass and rock crystal, the latter being the material generally known as "pebble," the distinctive adjective usually being taken from some remote district of high-sounding name.

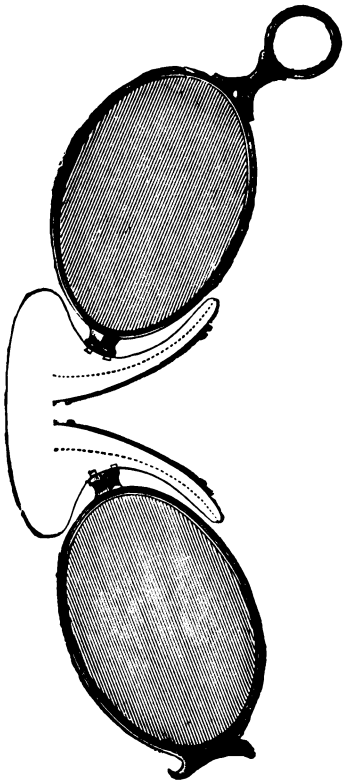


FIG. V.

A style of hard-rubber frames provided with springing rests that admit of a more delicate adjustment than those usually made of this material.

In this country Brazilian pebbles, Russian pebbles, etc., are common. It is interesting to know that as a nearer approach to these foreign countries is made, North American pebbles, Colorado pebbles, etc., are esteemed the most valuable.

The great object is to select that material which disperses light the least in proportion to its refractive power. Crown glass does this the least of all, and hence should be used for all glasses of great power. Opticians often claim the preference for pebbles on the ground that the polish on their surfaces is higher, and hence they do not scratch as easily; and that the material is perfectly white and transmits a pure light, while even the best glass has a greenish tint. Formerly this remark about the non-transparency of glass was true, but a perfectly transparent glass is now readily and cheaply available to all opticians, and transmits a pure, clear light. In this preference the greater object should overcome the lesser one; hence for glasses of high power, and especially concave ones, crown glass should be selected; for weak ones, and especially weak convex ones, one may with safety indulge in any prejudice for pebbles. By the use of the "pebble-tester," however, one often will find his supposed pebbles to consist of glass, and thus his ideas of the relative value of the different kinds encounter a rude shock. All oculists

and opticians should have this apparatus for the testing of lenses, and allow anyone to use it, or what is still better, be honest enough not to misrepresent the quality of their goods. This test consists of two plates of tourmaline, between which the lens is placed, and then held up to the window. If the lens be pebble, the light is polarized, and colored rings appear; if it be glass, no effect is produced. Pebble is also a better conductor of heat than glass, hence a lens made from it will seem colder to the tip of the tongue than one made from glass.

Furthermore, in order that a pebble lens may be of its greatest value, it is essential that its axis be at an exact right angle to the axis of double refraction, this latter being a peculiarity of pebble in one direction. But if care be taken in this respect, not so many lenses can be cut out of one piece of crystal, hence it is sometimes disregarded, and in consequence the image seen through them is more or less blurred and "fuzzy" on its edge. Resource being again had to the "pebble-tester," the defect can be easily detected; for if the lens be rightly cut, the rings of colored light will be circular; if not, they will be more or less irregular or eliptical in shape, or, as opticians usually say, prismatic colors will be abundant.

When glasses are once chosen they are not to be

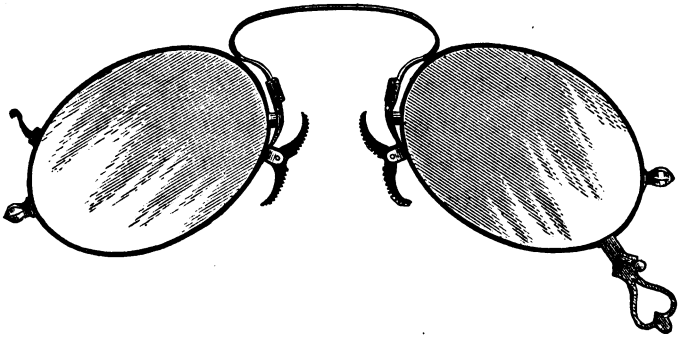


FIG. VI.

A style of frames much worn when the material used for their composition is gold. The peculiar shape of the nose-rests is designed to prevent their slipping, as is the tendency where a material as heavy as gold is used.

used interchangeably with those of anyone else who happens along.

Furthermore, it should be quite unnecessary to add that whatever kind of material for the lens be selected, the best of its kind should be used.

Different opticians often obtain great reputation by pretending to have superior glasses under the names of "clearers," "restorers," and such nonsense. A favorite trick also, with the unprincipled, is to give too strong glasses; these for a short time seem to make the sight better, but quickly fail to do so and cause the eyes to ache. It is best not to deal with those whose reputation is not known.

There are some opticians abroad, who, by a long course of honorable dealing, have justly won their favorable reputation, but they have no glasses which are not known in this country. Some of these glasses, however, have often obtained great reputation from travelers' tales of their great superiority. A person who is not skilled in a certain business is not competent to judge of the merits or wonders of that business. What are to some seemingly new and wonderful things, are often to others articles known for years. Perchance the products of our own town may be seen abroad for the first time, as every old European traveler can testify.

It is a very common occurrence after giving a short-sighted person a pair of concave lenses, or in trying to improve the vision with them, to have such person say, "Oh! yes, of course I see better; I see just as you see at the opera with a glass." An endeavor to explain that a person with normal sight always sees exactly as he now sees, provokes a hasty interruption to the effect that "You need not tell me that I am short-sighted, I see just as well as anybody, and never wore Spectacles in my life!" A lengthy explanation is required to convince, even in part, that vision is in any way deficient, so unconscious is the person that the full amount of sight is not present.

Anyone with normal sight desiring to know how poorly a short-sighted person sees without glasses, has only to place in front of his own eyes the convex glasses corresponding in number with the concave glasses worn by such short-sighted person. His eyes thus become the same in refraction as those of the short-sighted person without glasses, (that is myopic), and he has just the same amount of accurate sight—a fact difficult to believe, and always exciting compassion for the unfortunate myope.

How much more deficient the eyes of an astigmatic person are, can be readily determined by a perusal of

the causes of that trouble; it is almost impossible to accurately depict it.

There is quite a general belief, too, that dark-colored eyes, (eyes with dark-colored irides) are much stronger and less inclined to grow old than those of lighter color. There seems to be no foundation for such a belief. Perhaps as favorable statistics could be accumulated to associate a similar belief with red hair, or any other personal peculiarity. The eyes of all infants of whatever nationality or race are blue at birth, and remain so one to three weeks. This blue appearance is due to a lack of coloring matter in the iris, and is what is known as an interference phenomenon. The sky is blue for the same reason. At about the age mentioned, however, a pigment begins to be deposited in the iris which makes the color of the eye. There are occasional exceptions to this rule, as there are freaks of Nature of all kinds, but only enough to prove it. It would save a vast amount of maternal anxiety, and infantile eye disease, if all mothers knew this, and would not feel compelled to frequently pull the baby's lids open for the first week or two after birth, to find out the color of its eyes.

CHAPTER III.

SELECTION OF A PROPER FRAME; THE MATERIAL FOR ITS CONSTRUCTION; DANGERS OF EYE-GLASSES; THE GENERAL ADJUSTMENT OF GLASSES; COLORED GLASSES AND GOGGLES; THE DESTRUCTION OF ALL BENEFIT FROM A FAULTY POSITION OF THE GLASSES.

The proper kind of glass having been determined upon, it is important that the correct frame be selected. It is not enough that the lens is correct, its erroneous adaptation to the eye may defeat much gained by its use. The distance between the eyes should be considered, in connection with the shape and style of the nose, and an adaptation be made of some one of the kinds shown herein. Thus in a presbyope, with the eyes widely apart, and a thin, sharp nose, who desired eye-glasses, such a frame as Fig. I portrays would be unsuitable, because the centres of the lenses would be within the line of vision, in which case such a frame as Fig. II or Fig. III, would be required, as it would throw them out into the line of vision. Such styles as Fig. IV or Fig. V are sometimes useful. I do not like such as Fig. VI, but it is worn considerably. Figs. XVI, XIX, and XX are also much worn and convenient;

Fig. XXI not so much so. For astigmatic glasses it is essential that they should be set in "spectacle frames" and those which are known as hooks or riding-bows (Figs. VII, XVIII, and XXIII) are generally preferred. Some prefer the old "specs," similar to Figs. VIII or IX. Fig. XVII is another kind known as "Turn-pin Temples," greatly preferred by some, especially the aged.

Many other styles of frames with the material suitable for their construction, and the proper-shaped lenses, are also given in the plates. An examination of all—sufficient to be thoroughly familiar with them—should be made before any be chosen.

As to the material for the construction of the frames, it is often a matter of taste. Gold, especially, is too heavy for some kinds of eye-glasses, and inclines one to look older; rubber has the advantages of little weight, with no troublesome reflection of light from its surfaces, but is clumsy; the same remarks apply to horn or bone. Balancing all the defects and excellencies, I incline to nickle-plated steel. The plating insures no rusting, and can be easily replaced if worn off; the steel admits of delicate workmanship, the nickle-plating tends to make one look younger, and the total effect is pleasing. I order all kinds, however, and detect a growing tendency to the use of the rubber for

those who "bang their glasses around," as many say they do.

I am often asked if in the use of eye glasses there is danger from the pressure on the bridge of the nose. In one case I have known of a cancer located there, and its immediate cause attributed by a very intelligent gentleman to the pressure of tightly-pressing eye-glasses. The position of the lower lid is sometimes changed, and the lower punctum (the little hole for the drainage of the tears) displaced by the drawing, by which diseases of the lachrymal sac (the reservoir of the waste tears and other secretions,) may be induced or perpetuated, so that I am constrained to say that as often used I think they are dangerous. All this might be avoided, however, by proper care and a suitable mode of use.

When glasses are to be worn for seeing at a distance, the connecting bridge should be longer than when they are to be worn for near vision, because the visual lines are practically parallel; if for both near and far, a medium should be sought after. In addition, the lenses of the first should be set high, in order that they may correspond to the planes of the pupils, and for this purpose what is known as an X nose piece (Fig. VII,) is required. To see near objects, however, the lenses should be set low, and the lower edge of the lenses in-

FIG. VII.

A very light steel frame, with riding bows, and an X nose-piece. Suitable for a person requiring a medium position of the lenses as regards height.

clined backwards. For this purpose a nose-piece as is shown in Fig. XVIII or XXII, known as a K nose-piece, may be necessary.

Sometimes when a person has presbyopia (old sight) supervening on hypermetropia (over sight), or has absolute hypermetropia (complete oversight) it is convenient to have two pairs of lenses in one frame, the lower half of the lens stronger than the upper; or if myopic (short-sighted), with diminished range of accommodation, the upper half concave and the lower half convex. Such glasses are known as Franklin glasses, or glasses *a-double-foyer* (French; of double focus), and may be ground directly, or made of the half of two lenses cut and mounted in the same frame, as represented in Fig. X. If suitably adjusted, they are very convenient, and greatly liked by the wearer, but in the hands of many require such careful adjustment, constantly maintained, to keep each kind in place, that they weary and annoy.

These glasses derive their name from the philosopher, Franklin, who being slightly myopic with diminished powers of accommodation, required concave glasses for distance and convex for the near point.

The natural stimulant to the special nervous elements of the retina is sunlight, which is reflected by objects in their different colors. If blue-tinted glasses be or-

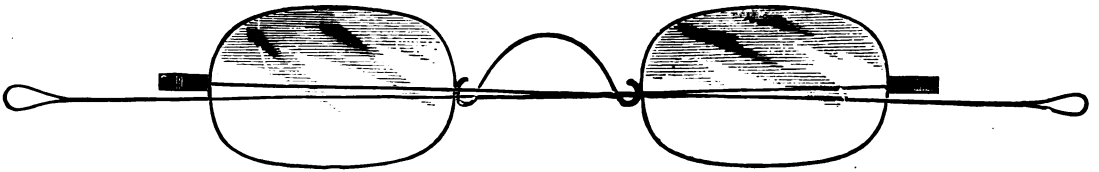


FIG. VIII.

A light-framed glass that meets with general favor from those who prefer spectacles to eye-glasses. Permits of easy vision over the lenses, as in speaking to audiences.

dered, certain colors are changed or shut out. This is often desirable for traveling in torrid climates, or on lakes, when the reflection from the water is strong, or in some morbid states of the retina, as in snow-blindness. To prevent the former troubles, these common glasses are all-sufficient; but what are known as stenopæic glasses are essential for the latter in arctic regions. Dr. Kane and other polar explorers, were compelled to use them. Formerly green protective glasses were given by oculists and almost universally used, but have been generally displaced by blue; for while the reflected green light is agreeable, transmitted is not, but rather irritating. It is often suggested by patients that green is preferable because the grass is green; but, reasoning in this same manner, the sky is blue, and the preference, I think, should be given to looking upward rather than downward in this world, all things considered. But if it is not desirable to so shut out or change certain colors, it is necessary to order a neutral tint known as gray, or London smoke, for these glasses exclude each color of the solar spectrum in equal proportions, and so simply soften the light. As already indicated, I do not approve of goggles (Fig. XXV.) Such protectors are unnecessary except of plain white glass to shut out the dirt and dust in high winds, and they confine the eye too closely and cause it to be half smothered in

its own vapors. They thus often perpetuate the trouble sought to be relieved, as in granulated lids, etc.

Lenses of any power, however, may be of a blue, green, or neutral (London smoke) tint, as may be necessary or desirable in different forms of trouble. It is often better not to order them ground in tinted glass, for the glass being of varied thickness, the shade is unequally distributed over the field of vision, especially in the stronger glasses, but preferable to attach to one of the surfaces a colored plain glass by means of Canada balsam.

Oftentimes even when great care has been taken to select and adjust suitable lenses, the whole is jeopardized or overturned by the light, or its manner of use. As an example, blue glasses may be carefully selected to be worn at night; the person takes them home and sits down to read by a light having a translucent green shade, thus changing the color of the transmitted light. By this means the light reaches the eye composed of the color engendered by the combined blue and green, which is not that originally intended.

Again glasses will be selected for a person who is old-sighted to be used by a good light at a distance of say twelve inches. The glasses, on the contrary, are used in a dim light at a distance of thirty inches, when, as a matter of course, the whole adjustment of the eye

FIG. IX.

An old style of steel frames still much worn by those who prefer a plain, useful kind of frame, and whose shape of face admits of their suitable adjustment.

is strained, and vision becomes painful or blurred after a short time.

The correct position for the light in the use of glasses for reading, is behind and to the left of the head, and strong enough to illuminate the paper well. The book or paper should be held about twelve to fourteen inches from the eye, and an erect and comfortable posture maintained.

For those who have to select their work for evening and such times, it will be found that writing is generally read easier than printing at such a time; that composing is easier than copying; and that a frequent change from one occupation to another will assist in keeping the strain on the accommodation to a minimum.

A further consideration of this subject will be found in Chapter XIII.

CHAPTER IV.

THE OLD AND NEW WAYS OF NUMBERING LENSES; THE DETERMINATION OF THEIR REFRACTIVE POWER; TABLES SHOWING THE EQUIVALENTS OF DIOPTRIES IN ENGLISH AND FRENCH INCHES, AND IN MILLIMETRES, ACCORDING TO THE INDEX OF REFRACTION.

Lenses being so often demanded in the treatment of the eye, a clear understanding of the manner of their construction and measurement is as necessary as of their adjustment. Unfortunately, just now is a transition period in their nomenclature, rendering it a matter of more than ordinary difficulty; for like the change in the nomenclature of chemistry, it requires a knowledge of both kinds to understand current literature. An endeavor will be made, however, to make both systems plain, with the reasons for the change.

Up to about the year 1860, when the present system of measurement of lenses in inches was practically introduced, there was no way of numbering lenses. A manufacturer might make twenty grades of lenses and number them from 1 to 20; another might make only twelve grades of lenses (embracing the same range), and number them from 1 to 12; and so on, so that the

number 10 of one manufacturer might be the number 7 of another, and the number 13 of another, etc. To overcome this, it gradually came to be understood that the number of the glasses indicated their focal length in inches. But the refracting power of a lens also depends on the index of refraction of the glass, varying with the kind of which it is composed. Now the Parisian inch is the equivalent of 27.07 millimetres; the English of 25.30; the Austrian of 26.34; and the Prussian of 26.15; while the index of refraction of the glass of which lenses are constructed varies all the way from 1.526 to 1.534. Hence there are sources of error in all calculations, for even though the country is known where the lenses are made (presumably on the standard of that country), the refracting power can never be told unless the index of refraction of the glass is known as well. In order to simplify the latter, a common index of refraction of 1.5 was accepted, but even with that wrong basis, only part of the trouble was removed, so that as a compromise it became generally accepted that the number of a lens indicated both the focal distance and the refracting power. Thus, a lens numbered 9 had a focal distance of nine inches, and a refracting power of 1-9. But it was really known all the time that it had not, and it in no wise made an intelligent person feel that he had solved

a practical matter by trying to deceive himself with what he knew to be wrong. In other words a sensible system of notation would indicate either the power of refraction or the focal distance of a lens. This old system did neither, and by making the unit too strong necessitated the constant use of fractions in all calculations. Practically we have much more to do with the refracting power of a lens than with its focal distance. The refracting power is always the inverse of the focal distance. The numbers of the old system give the focal distance of the lens in inches, the unit being a lens of one inch with a refracting power of 1-1. There is seldom need of this lens in practice, and it is not put in trial cases.

To obviate these difficulties, many oculists offered plans and introduced them at different conventions. As a result, at the International Congress of Ophthalmology in 1867, a new system of numbering all lenses according to the refracting power was proposed. After a short delay, that which is known as the new or the metrical system, was adopted. A lens of one metre (instead of one inch as in the old system) focal distance was selected as the unit, called a dioptry, and numbered 1. This *dioptry* (a metre) is the equivalent of 100 centimetres, 1,000 millimetres, or 39.33 English inches. Thus by following the cardinal numbers, we

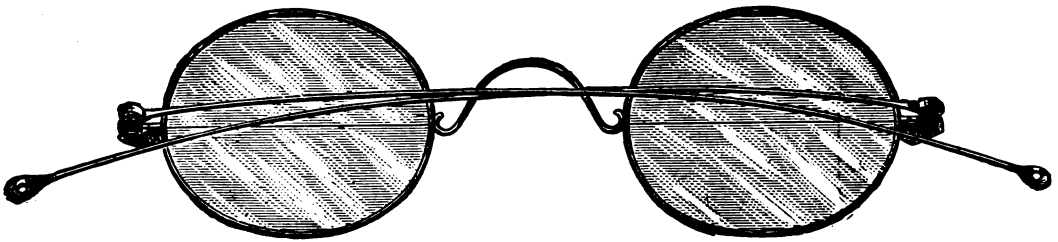


FIG. X.

Spectacle frames holding lenses which are known as Franklin glasses. So called after that great Philosopher, who wore them. Their peculiarities are fully explained in the text.

have a series of lenses with an interval of one dioptry, as No. 2 is twice as strong as No. 1; No. 20 twenty times as strong as No. 1. Unfortunately there is need of lenses weaker than one dioptry, and at intervals between dioptries, so that this system does not after all remove the need of fractions, and there are lenses of .25 and .50 dioptry, 1.75 and 2.50 dioptries, etc.

For convenient reference and a ready determination, the following tables are given:

The equivalents, in English and French inches and in Millimetres, of each dioptry or fraction of a dioptry where the index of refraction is 1.5:

DIOPTRIES.	FRENCH INCHES.	ENGLISH INCHES.	MILLIMETERS.
.50	73.8816	78.7416	2.000
.75	49.2544	52.4944	1.340
1.	36.9408	39.3708	1.000
1.25	29.5526	31.4966	800
1.50	24.6272	26.2472	667
1.75	21.1090	22.4976	571
2.	18.4704	19.6854	500
2.25	16.4181	17.4981	444
2.50	14.7763	15.7483	400
2.75	13.4330	14.3166	363
3.	12.3136	13.1236	333
3.25	11.3664	12.1141	307
3.50	10.5545	11.2488	285
3.75	9.8509	10.4988	266
4.	9.2352	9.8427	250
4.25	8.6919	9.2637	235
4.50	8.2090	8.7500	222
4.75	7.7978	8.2886	210
5.	7.3881	7.8741	200
5.50	6.7165	7.1583	181
6.	6.1568	6.5618	166
7.	5.2772	5.6243	143
8.	4.6176	4.9213	125
9.	4.1045	4.3745	111
10.	3.6940	3.9370	100
11.	3.3582	3.5791	90
12.	3.0784	3.2809	83
13.	2.8416	3.0285	77
14.	2.6386	2.8122	71
15.	2.4627	2.6250	66
16.	2.3088	2.4606	62
18.	2.0522	2.1872	55
20.	1.8470	1.9685	50

The equivalents in Millimetres and Paris inches where the index of refraction is not 1.5 but 1.53, which is generally more correct, and should have the preference.

NEW SYSTEM.

DIOPTRIES.	FOCAL DISTANCE IN MILLIMETERS.	FOCAL DISTANCE IN PARIS INCHES.	NUMBER IN OLD SYSTEM.
.25	4.000	148.	156.
.50	2.000	74.	78.
.75	1.333	49.	52.
1.	1.000	37.	39.2
1.25	800	29.6	31.2
1.50	666	24.6	26.1
1.75	571	21.	22.3
2.	500	18.5	19.5
2.25	444	16.4	17.4
2.50	400	14.8	15.6
3.	333	12.3	13.
3.50	286	10.5	11.1
4.	250	9.23	9.78
4.50	222	8.22	8.7
5.	200	7.4	7.8
5.50	182	6.71	7.1
6.	166	6.15	6.5
7.	143	5.29	5.59
8.	125	4.6	4.89
9.	111	4.1	4.35
10.	100	3.7	3.91
11.	91	3.37	3.56
12.	83	3.07	3.26
13.	77	2.84	3.01
14.	71	2.63	2.8
15.	67	2.47	2.60
16.	62	2.3	2·44
17.	59	2.18	2.30
18.	55	2.03	2.17
20.	50	1.85	1.95

The same when the index of refraction is not 1.5 but 1.53, etc.

OLD SYSTEM.

NUMBER.	FOCAL DISTANCE IN PARIS INCHES.	FOCAL DISTANCE IN MILLIMETERS.	EQUIVALENT IN DIOPTRIES.
72	67.9	1837	0.54
60	56.6	1523	0.65
48	45.3	1225	0.81
42	39.6	1072	0.93
36	34.	920	1.08
30	28.3	766	1.30
24	22.6	612	1.63
20	18.8	509	1.96
18	17.	460	2.17
16	15.	406	2.46
15	14.1	383	2.61
14	13.2	357	2.8
13	12.3	332	3.
12	11.3	306	3.26
11	10.3	280	3.56
10	9.4	254	3.9
9	8.5	230	4.35
8	7.5	203	4.9
7	6.6	178	5.6
6½	6.13	166	6.02
6	5.6	152	6.52
5½	5.2	140	7.12
5	4.7	127	7.83
4½	4.2	115	8.70
4	3.8	102	9.72
3½	3.3	89	11.2
3¼	3.1	83	12.
3	2.8	76	13.
2¾	2.6	70	14.4
2½	2.36	64	15.7
2¼	2.1	57	17.4
2	1.88	51	19.6

CHAPTER V.

HOW TO TEST THE EYES; TEST-CASES; DIFFERENT STYLES EXPLAINED; THE ADJUSTMENT OF LENSES OF DIFFERENT POWERS TO COMPANION EYES; THE RIGHT EYE GENERALLY THE ONE USED FOR FIXATION; POWER OF THE TWO EYES IN FUSING OBJECTS; DISADVANTAGES OF THE LOSS OF AN EYE.

To make use of these tests and to adjust lenses, "trial cases," or "test-cases" are necessary for one who is not skilled in the branch of ophthalmoscopic optometry that treats of measuring the refraction of the eye with the ophthalmoscope.* This power is usually acquired by oculists only, and even with them, advantage is derived from being able to confirm their estimate of the refraction when taken by the latter method.

These trial cases, when complete, are composed of sample glasses of the various kinds known, with which the applicant for glasses tries or tests his eyes himself, the examination being subjective. When the correct lenses are thus found by trial, the oculist orders duplicates of such lenses for the patient to wear, they being ground and set in any suitable frame as before indi-

* This subject is fully explained in the author's work entitled "The Ophthalmoscope; its Theory and Practical Uses."

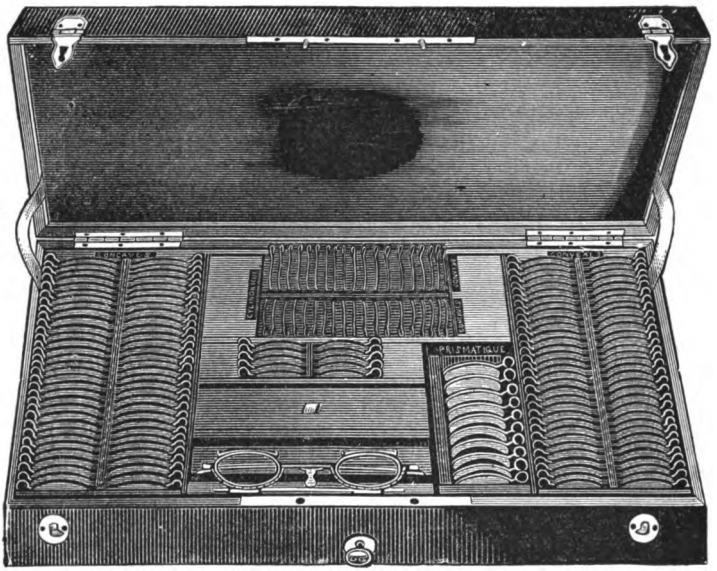


FIG. XI.

NACHET'S SET OF TRIAL GLASSES.

Comprises when complete, 33 pairs each of spherical, convex and concave lenses from 2 to 144 inches focus; 22 pairs each of cylindrical, convex and concave lenses from 5 to 144 inches focus; 10 prisms of angles from 2 to 20 degrees; 4 plane colored glasses; one white glass disc; 1 half-ground surface; 2 metal discs with stenopaic slit, 1 metal disc with hole, and 1 solid; 1 adjustable spectacle frame, with revolving graduated fittings for holding the various lenses, and 1 single non-graduated.

This case has only one cylindrical concave and convex lens of each number, and one trial frame.

cated. With the ophthalmoscope, however, the examination is entirely objective, or the oculist names the right glass unaided by the applicant. Such trial cases when complete are, as a matter of necessity, more or less expensive. One of the best, though not complete, known as Nachet's, is represented in Fig. XI. Such a case is now quoted at $90.00 net.

One of the principal reasons why students and physicians in general practice do not give more attention to optical defects, has been due to the cost and supposed intricacy of the glasses necessary. By the aid of the metric system, simple combinations can be made without any knowledge of mathematics whatever.

To render trial-cases as inexpensive as possible, in order that more might have them, has been the study of a number of oculists for some time past. As a sequence, different cases have appeared as time has elapsed.

One of these, second only to Nachet's in point of utility, is the case arranged by Loring, and illustrated in Fig. XII. Like the ophthalmoscope devised by him, it is valuable, nearly equaling in efficiency those of larger size and more complete equipment. For those practitioners who have considerable fitting of Spectacles, and are not pressed for time, it will prove especially serviceable.

FIG. XII.

LORING'S SET OF TRIAL-GLASSES.

Contains one pair each of the following dioptry numbers:

Spherical, concave and convex: .25, .5, 1., 2., 3., 4., 8.
Cylindrical, concave and convex: .25, .5, 1., 2., 3.

Also a set of Test-Types, and a triple-grooved graduated trial-frame, into which one, two, or three lenses may be slipped to obtain by combination the desired number.

There is, moreover, considerable advantage to the comparatively inexperienced in having a pair of similarly numbered glasses. With them both eyes can be simultaneously examined with glasses of equal strength.

The following numbers can be made by singly using, or combining the numbers contained in the case:

Spherical: .25, .5, 1., 1.25, 1.5, 1.75, 2., 2.25, 2.5, 2.75, 3., 3.25, 3.5, 3.75, 4., 4.25, 4.5, 4.75, 5., 5.25, 5.5, 6., 6.25, 6.5, 7., 7.25, 7.5, 8., 8.25, 8.5, 8.75, 9., 9.25, 9.5, 10., 10.25, 10.5, 11., 11.25, 11.5, 12., 12.25, 12.5, 13., 14., 15.

Cylindrical: .25, .5, .75, 1., 1.25, 1.5, 1.75, 2., 2.25, 2.5, 2.75, 3., 3.25, 3.5, 3.75, 4., 4.25, 4.5, 5., 5.25, 5.5, 6.

Its price is $14.00.

But in the endeavor to cheapen cases by removing more and more glasses, their efficiency rapidly declines, and one often finds that a case is expensive enough to require quite a sum of money without being of sufficient usefulness to compensate for the outlay.

Fig. XIII is a representation of a set which barely escapes falling into this category; for I think when one has to pay for it $12.00 (its price), the sum has already become so large that it would be better to pay more and get a completer one.

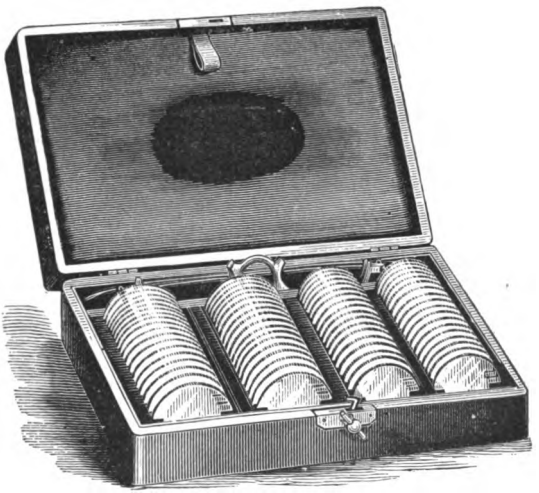


FIG. XIII.

CONDENSED SET OF TRIAL LENSES.

Comprises eighteen pairs each of spherical convex and concave lenses from Nos. 5 to 60, directions and test-types for the testing of vision and the diagnosis of some common optical defects. Designed for the general practitioner by D. B. St. John Roosa, M. D.

Contains no cylindrical, or lenses other than spherical.

Fig. XIV is a representation of a case arranged with a view to assist those who wish to pay the least possible for one that will enable them to test the refraction and diagnosticate diseases incident thereto.

Its total cost is $4.00,* a sum so small as to warrant its purchase by all, even though each has very few cases to treat. With it, there can be diagnosticated and fitted any case of refractive error that comes in the range of the set described before it, or that can be corrected by any case containing only the ordinary spherical lenses; and while it cannot be justly claimed that it is as convenient or useful as the expensive ones, it combines all that is essential for those who, having few cases, wish to economize money at the expense of time.

This lowering of the number of glasses without sacrificing the utility of the lenses is brought about by combining them, when necessary, in a clip. Using them singly, or placing one or more behind another according to the following table, there can be formed all ordinary, viz., the following

*Messrs. Duncan Bros., 133 Clark St., Chicago, will supply the case and this book, free by express or mail, for $5.00.

COMBINATIONS.

NEW SYSTEM. DIOPTRIES.	CONVEX.	CONCAVE.	APPROXIMATE EQUIVALENTS IN OLD SYSTEM.
.5	+ .5	— .5	1-72
1.	+ 1.	— 1.	1-36
1. 5	+ 1. + .5	— 1. — .5	1-24
2.	+ 5. — 3.	— 5. + 3.	1-18
2. 5	+ 3. — 5.	— 3. + .5	1-15
3.	+ 3.	— 3.	1-12
3. 5	+ 3. + .5	— 3. — .5	1-11
4.	+ 5. — 1.	— 5. + 1.	1-9
4. 5	+ 5. — .5	— 5. + .5	1-8
5.	+ 5.	— 5.	1-7
5. 5	+ 5. + .5	— 5. — .5	1-6⅞
6.	+ 5. + 1.	— 5. — 1.	1-6
6. 5	+ 5. + 1. + .5	— 5. — 1. — .5	
7.	+ 5. + 3. — 1.	— 5. — 3. + 1.	1-5
7. 5	+ 5. + 3. — .5	— 5. — 3. + .5	
8.	+ 5. + 3.	— 5. — 3.	1-4½
8. 5	+ 5. + 3. + .5	— 5. — 3. — .5	
9.	+ 5. + 3. + 1.	— 5. — 3. — 1.	1-4

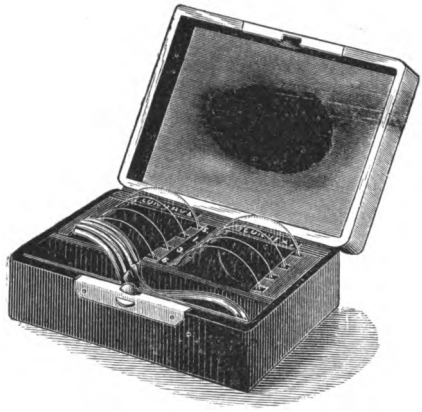


FIG. XIV.

SMALL SET OF TRIAL LENSES.

Contains eight lenses; spherical, concave and convex: .5, 1. 3., 5., Dioptries.

The lenses are also marked in inches. It contains, in addition, a triple-grooved clip for holding the lenses while testing the vision. When desired, a similarly grooved spectacle frame, by which the efficiency will be greatly increased, may be ordered with it at a slight additional expense.

It is essential in all cases to test the eyes separately, for it is not at all uncommon to find them differing in their refractive power.

The lenses being marked in the metric system, as well as in the old inches, in ordering Spectacles, if the new system is used, the numbers should be designated by a "D" (Dioptry) following each number thus: .5D., 1.D., etc.

At first glance, it seems to all that there could be no objection to giving a glass suitable for the correct measurement of the refractive power of each eye; indeed, it seems the sole and sensible way to meet the anomaly. But as will be explained in Chapter VI., we do not see with the eyes, they acting simply as an optical box, but with the brain. Convex lenses enlarge the image of an object, and concave ones diminish it. If there be placed before one eye an enlarged image, as would be brought about by the use of a convex glass essential in the case of a hypermetropic (over-sighted) eye, and a diminished image before the other eye, as would be produced by a concave lens essential in the case of a companion myopic (short-sighted) eye, the effect would be the same as in endeavoring to see two similar objects at once with one eye. Neither would be seen well, but both would appear "fuzzy" and indistinct. There are exceptions to this rule, as to all others, but

the general principle holds good. The practical difference found to exist, if it does not exceed 1-48th or 1-60th of an inch, may be neutralized in both eyes by the correctly fitting glasses; when it exceeds this, it will be found the better rule to fit the better eye, that is the one with the better sight, and give a corresponding glass for the other eye. It by no means is always true that the eye with the better refraction is the better one for vision, for it may be amblyopic, and hence not see as well as the other which has the poorer refractive power.

If, however, the eyes are to be used for any purpose requiring accuracy of fixation, as in rifle-shooting, or the determination of lines, as in surveying, etc., it will generally be found that the right eye must be the one to be fitted; for on trial it will be found that we all usually give the preference to the right eye in such matters. This may quickly be made manifest on attempting to place the finger in the line of vision when both eyes are directed to the same object. It will be found that the finger is in the way of the visual line of the right eye, and this where both eyes are about the same in visual power. Another good way of proving this is, when both eyes are in a casual manner looking at an object in front of a prominent background, to place a card in front of one and then the other. It

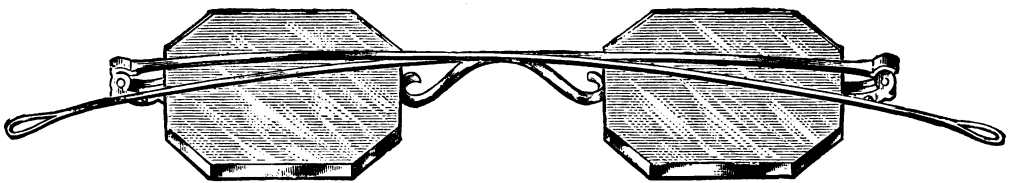


FIG. XV.

Heavy, coin silver Spectacles, with octagonal shaped lenses and frames. Not very much worn, the material used in the construction of the frame being too heavy to admit of popularity.

will be found that when the card is in front of the left eye, the disappearance of that portion of the background directly in front of that eye will scarcely be noticed, but when it is in front of the right eye, the disappearance of the portion alone visible to that eye will at once be missed.

Those who shoot much, as at a target, may find assistance from what are known as shooting-glasses. These Spectacles are made of ground opaque glass, with a yellow colored disk in the center, the effect of which is to define distant objects more clearly.

The stereoscope also affords a good test of this kind; for a person with marked difference between the eyes, cannot fuse the images well, and complains of their indistinctness. Persons troubled with asthenopia (weakness of vision) whether dependent on weakness of the accommodative apparatus, the globe muscles, or of the retina, usually quickly tire and complain of the fatigue of looking through this same popular instrument of diversion.

The ascertainment of just where the trouble lies in these cases is a matter of particular and careful study, and requires an extended knowledge of the physiological, pathological and optical questions involved.

One eye is not nearly as good as two, notwithstanding such is commonly thought to be the case. Persons

with one eye do not perceive as readily as those with two, and where form and position are concerned, often err in judgment. They also perform delicate operations slowly, and often without accuracy.

CHAPTER VI.

HOW THE SIGHT IS MEASURED; OLD AND NEW METHODS; THE ADJUSTMENT OF SPECTACLES IN GENERAL FOR MYOPIA, HYPERMETROPIA AND ASTHENOPIA; GENERAL HINTS AS TO THE CARE AND CONVENIENT USE OF SPECTACLES; WE DO NOT SEE WITH THE EYES.

In order to make a practical application of Spectacles, it is essential to have in addition to a trial-case, as described heretofore, a selection from what are known as Test Types. For this purpose there have been chosen a carefully assorted number from those known as Jaeger's and Snellen's, which will be found in the back part of this book. With these appliances any physician or surgeon may diagnose and fit any ordinary case of refractive error. By them, also, the laity who are remote from points where competent aid may be had, will be greatly aided in the proper selection of their glasses. Indeed, with a careful study of what is given herein, they will as guides be far superior to that class to whom in those districts, is entrusted this delicate matter. It must not be expected that the more difficult cases will be quickly mastered; such should be referred to one who has made of these subjects a study

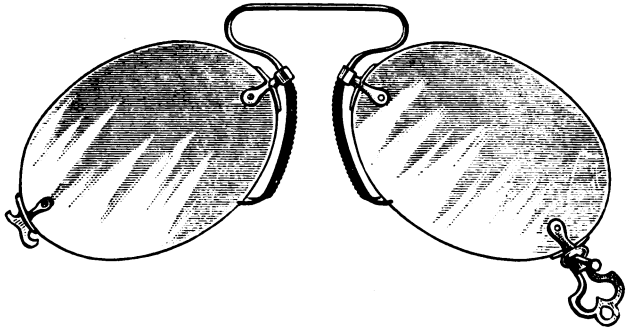


FIG. XVI.

A style of lenses where no frame is used; the bow and other parts being attached directly to the glasses. Greatly preferred by some on account of their light appearance.

sufficient to understand what is known, and to take a comprehensive view of the whole matter.

In explanation of these test-types and their names, it should be understood that for a number of years much confusion resulted from there being among oculists no uniform way of testing vision. To overcome this, it was agreed, by common consent, to make use of a set of letters drawn upon a given scale. Snellen and Jaeger both devised such sets, and as each has merits peculiar to itself, both are used; the former being considered better for the determination of the acuity of vision, and the latter for the ease of reading. Snellen's letters are square and their size increases in a definite ratio, so that each kind is seen at an angle of five minutes, No. 3 being seen at a distance of three feet, No. 2 at a distance of two feet, and so on. As a rule, these letters cannot be seen distinctly beyond these distances.

Quite recently the standard of measurement has, by vote of an International Congress, been changed from inches into dioptries, so as to have a uniform standard—the foot and inch, which have been taken as the standard, varying in different countries. This has been explained in a preceding chapter. The same unit of measurement, the dioptry, which was taken for the measurement of Spectacles, as has also been explained,

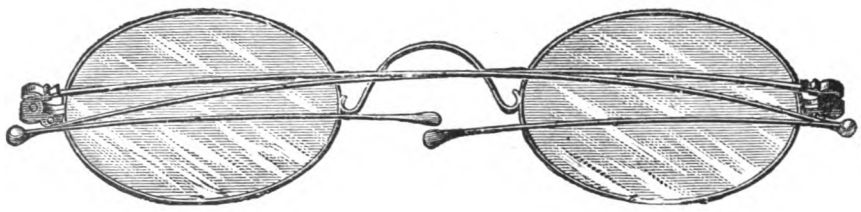


FIG. XVII.

A style of frame known as "Turn-pin Temples." Not much worn, but suitable for those who desire one which feels firmer, and is more strongly fastened than the usual kinds.

is again used here. It is the equivalent of 39.3 English inches; by calling it forty inches, which is correct enough for all ordinary calculations, the change from one system to the other can be easily made.

A person who has normal sight reads the test types at the distances corresponding to the numbers marked thereon. Thus, if in feet, No. 200 is read at 200 feet, No. 20 at 20 feet, and so on. The dioptry card is divided into 60, 20, and 6 dioptries respectively, which will be seen to be the nearest approach to the old foot measure that could be selected and easy calculations be retained. So that if the new system be used, No. 60 is read at 60 dioptries, (nearly 200 feet), and No. 6 at 6 dioptries, (nearly 20 feet), and so on.

Now, if an eye be suffering from diminished acuity of vision, in order to gain large retinal images, it will demand a larger retinal angle than five minutes to see the letters, and hence No. 1 cannot be seen at one foot, but for example, only at a distance of six inches, and so on.

If, then, the card be placed at a distance of twenty feet, or, according to the new nomenclature, at a distance of six dioptries, and the observer see No. 20 of the first, or 6 of the second, plainly, his vision is perfect, 20-20ths, or 6-6ths. If, however, he can only see that which should be seen at 70 feet, his vision is

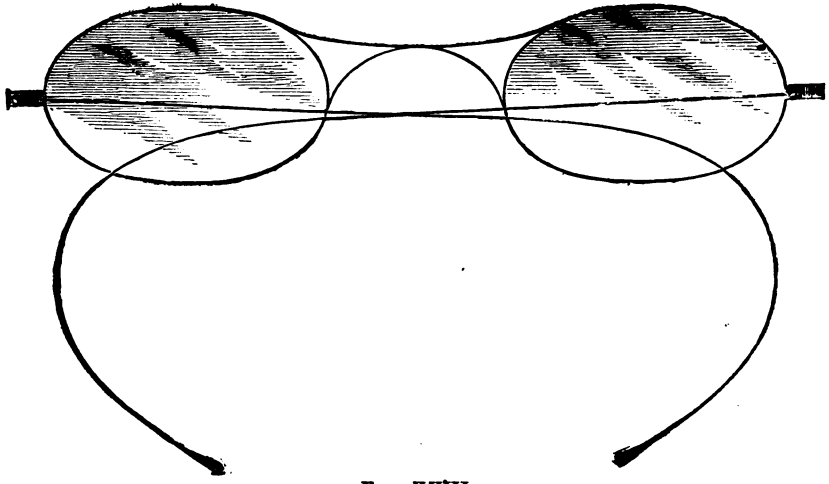


FIG. XVIII.

A light steel frame similar to Fig. VII, but with a K nose-piece. An agreeable frame which is much worn.

20-70ths, or about 2-7ths what it would be were it normal. In practice the fractions should never be reduced, but the denominator allowed to remain the distance at which the test types should be seen, and the numerator the distance at which they are placed. The eye in a state of rest depends on the refraction alone, but when viewing any object nearer than about eighteen feet, the accommodation is used, so that practically 2-7ths is not 20-70ths. In the former case the expression would mean that the types used should be seen at 7 feet, and were only seen at 2 feet, the accommodation being used, or in a condition where it might be used if not diseased, (an element always to be borne in mind). In the latter case the expression would mean that the types should be seen at 70 feet, but were only seen at 20 feet, the refraction alone being used, (as the distance at which the types were placed was such as to preclude the use of the accommodation, for it must be at rest at a distance of 20 feet). Moreover, there is some advantage in using the scale of tens when fractions are involved, as will be seen when the adjustment of lenses is attempted.

Jaeger's types are not square, but similar to those in ordinary use. We have already become familiar with them in ordinary reading, hence they are the more readily seen and recognized.

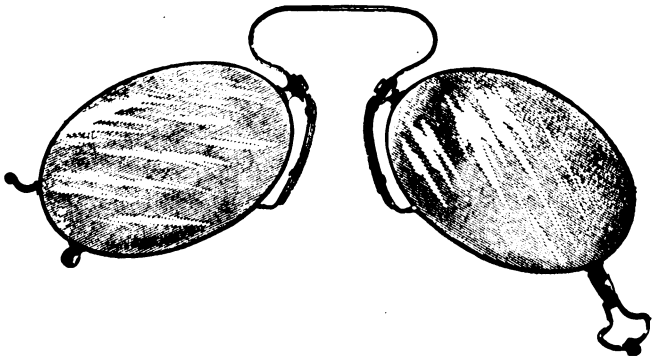


FIG. XIX.

A light steel frame, which, when nickel-plated, is very much worn. Preferred on account of its delicacy and genteel appearance.

Other styles have been devised, but, as those described are in general use throughout the civilized world, a description of them seems superfluous.

Under the various heads of Hypermetropia, Myopia, etc., where the subject is further considered, hints are given as to the correct way to adjust glasses. The adjustment of glasses for asthenopia (weak-sight) is not considered, because they ought not to be worn for such an affection unless medical means fail. Much can now be done by remedies exclusive of lenses, and the too common habit of putting on lenses for this trouble ought to be abandoned, unless done by order of an oculist. But there are several little points that assist in making their use pleasant that belong to no one heading; hence they will be considered here.

To one who is familiar with the great value of Spectacles, it is annoying to see what little care is taken of them. Some persons will go a whole lifetime obeying the most trifling superstitions regarding the wetting of their eyes with saliva before opening them in the morning, or always putting their head in the wash-basin and turning it over sideways to prevent injury to the delicacy of the lid movements, etc. Then, when age comes on and Spectacles are a necessity, they will struggle with a scratched, greasy pair, trying to see some dim embroidery or mechanical work, until weak

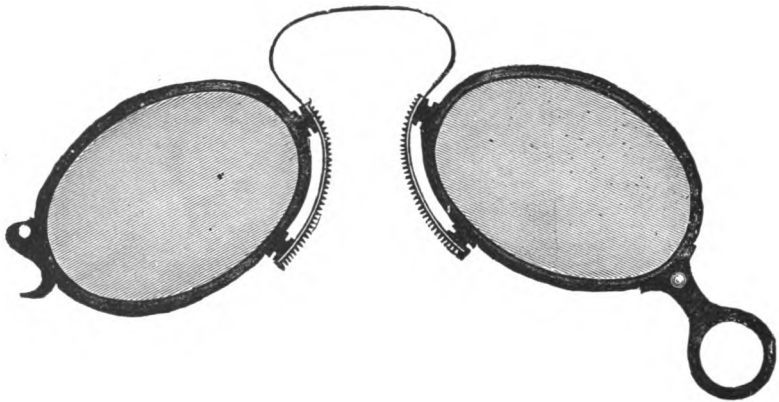


FIG. XX.

Hard-rubber frames, with steel spring covered with serrated edges of hard-rubber. A popular style with those who do not object to the bulky frames.

vision becomes fixed, accompanied with red and unsightly lids. Such persons are also, as a rule, the last ones to change for a new pair, and multiplied defects increase the dimness of the already troublesome vision.

Eye-glasses are nearly always worn pinching the nose too tightly; this is not only wholly unnecessary, but unpleasant and not entirely free from danger. The pressure on the nose may cause trouble with the ducts, and, as has been said before, this may be the cause of more serious difficulties. If the spring be too strong, heat it a little in a flame, and carefully bend it until it is of the requisite strength.

Neither should the glass be worn so near the eye as to gather the moisture or rub against the lashes. At the best, lenses grow "steamy" on going from a cold to a warm atmosphere, or the reverse. This becomes a serious annoyance when it is complicated with any other apparently trifling error.

Do not buy a fine pair of glasses, and then spoil them by scrubbing them, when soiled, with anything that comes handy for the purpose. Good lenses are quite easily scratched. Use a piece of chamois skin, or what is known as wash-leather, to clean them, and then put them in a case.

Always have eye glasses attached by a cord to the person who uses them, for this will save breaking

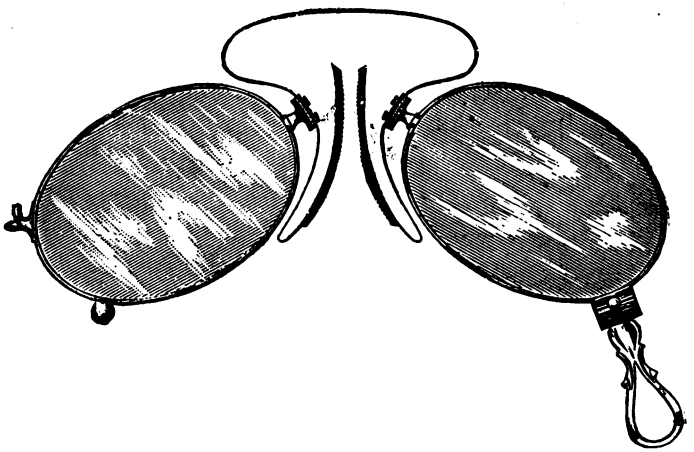


FIG. XXI.

A style of gold-framed lenses similar to those worn in hard-rubber frames. Preferable to those of heavier manufacture.

them by accidental falls, not to mention the frequent searches for them, which is so vexatious to those requiring their aid. A hook to be pinned to the clothing, illustrated in Fig. XXXIII, on which they may be hung, will also be found very useful.

Short-sighted glasses should be worn near the eyes; over-sighted ones not necessarily so. Astigmatic glasses, should be carefully kept in the exact position ordered by the oculist, otherwise they impede, rather than benefit vision.

Finally, it should be understood that we do not see with the eye, but with the brain; hence it is that the eye may be perfectly fitted as to its refraction, the image perfectly formed, and yet no vision be present, the sensorium taking no cognizance of the image present. A remembrance of this fact, which can only be diagnosticated by a competent medical person, will afford a solution to many otherwise unsolved, and seemingly incomprehensible, optical problems.

CHAPTER VII.

THE ADJUSTMENT OF GLASSES FOR HYPERMETROPIA; DIRECTIONS FOR BEGINNING THE EXAMINATION IN CASES OF SUSPECTED NEED OF GLASSES FROM ANY CAUSE.

A person desiring glasses for hypermetropia, or whose vision is suspected to be imperfect, should be seated at twenty feet from No. 20. If every letter seems black and the outlines of the letters clearly defined, he apparently has normal vision for distance, but may still be over-sighted (hypermetropic). In order to determine this, place in front of his eye a plus 72 inches lens, and let him look at No. 20.* If the letters are slightly dimmed, or less distinctly seen, the eyes are normal for distant sight. If, however, with such a lens the sight continues as good as before, try a plus 36 inches lens; if he still sees as well, try a stronger, and so on until he says the letters are getting dimmed. The manifest hypermetropia is now overcome, but most likely there is some latent. The strongest lens with which sight is as good as it is without

* The difficulty of adjusting lenses by the different systems of nomenclature will be apparent at the outset of practical work. Therefore to compel a practical familiarity with them, the author has made use of both systems at times. A reference to the tables already given will soon render this easy, though the number of the glass is usually marked in both inches and dioptries. It will be well to use the new system wherever possible.

it, represents the manifest hypermetropia. With this trouble, however, as with myopia, there is danger of confounding spasm of the ciliary muscle. A more complete description of the latter affection will be given further on; it requires skill to detect it.

The total hypermetropia is determined by paralyzing the accommodation with atropine and then selecting a lens of sufficient strength to render distant objects clearly visible. This lens represents the total hypermetropia.

When atropine is used, it is best for the patient's convenience and comfort to test only one eye at a time, allowing the influence of the drug to pass off before subjecting the other eye to its power.

It is well to completely paralyze the accommodation in cases which seem to require special examination. This is effectually done by instilling three times a day, for one or two days, a drop of the following solution;

℞ Atropiæ sul. gr. iv,
Aquæ dest. ʒj, M.

As a rule, it will be found, in practice, that the strength of the lenses to be prescribed for individual cases should not be sufficient to correct the total hypermetropia. Correction of the manifest hypermetropia with a small amount of the latent, is often sufficient at first, and relieves any asthenopia (loss of strength of the eye)

due to the affection. Lenses sufficient to do this may be worn until an additional amount of the latent hypermetropia becomes manifest, and then be replaced by stronger ones.

The correction, at first, of the total hypermetropia, is found practically to be attended with more or less discomfort to the patient; for it is seldom that a patient can at once wholly dispose of his habit of accommodating. His involuntary accommodation added to glasses of full strength, renders his refraction in effect myopic. He must, therefore, by easy stages, be educated to the use of stronger and stronger glasses, until he has become accustomed to the use of those which are equal to his total hypermetropia.

For children affected only in a slight degree, and in whom the accommodative apparatus is in full vigor, glasses which overcome the hypermetropia for distance are all that may be required for many years. For old people, in whom the power of accommodation is nearly lost, glasses equal to the total hypermetropia may generally be prescribed at once.

In regard to the use of Spectacles, it is best that it should be constant. If the glasses are laid aside at intervals, a return of the old symptoms is apt to follow, and no progress will have been made in overcoming the disorder of the accommodation. However, in

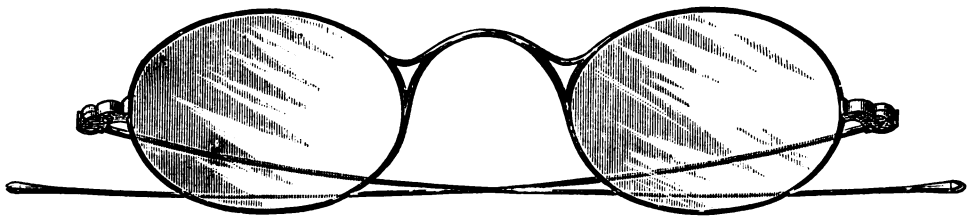


FIG. XXII.

"Pantoscopic Spectacles," so called from the ease with which vision of all objects is obtained. The shape of the bridge, permitting it to rest low on the nose, enables one to see over the lenses, while the joints being set at a sharp angle to the plane of the lenses, the Spectacles are always tilted. Hence the wearer may sit erect. Especially adapted to desk-work and similar occupations.

young persons who experience no inconvenience, except while engaged in near and fine work, the Spectacles may meet all requirements if worn only while engaged in such work.

In advanced life, after presbyopia has set in, hypermetropes often require two pairs of glasses, the stronger for near, and the weaker for distant vision.

When Spectacles of a high power are required, as in near vision in hypermetropia of high degree, the centering and adjusting the lenses properly, is a very important matter. By centering is meant that the lenses should be so adjusted as to allow the visual lines to pass very near, or directly through, their axes.

The necessity of this precaution will be very evident if the reader reflects that when light passes too near the edge of either a convex or a concave lens, the lens acts as a prism.

So close is the association between the functions of accommodation and convergence, that a slight disturbance in their equilibrium (as by the action of improperly centered lenses) may be attended with very painful nervous symptoms. It should also be remembered that notwithstanding the lenses may be properly centered, they cannot change with the movements of the eye.

If the visual lines always remained in the same rela-

tion to the centers of the lenses, or, in other words, if the eyes always maintained the same degree of convergence and only moved in exact conjunction with the movements of the head, Spectacles could be so centered and adjusted as to be always a fixed and reliable factor in the visual apparatus. But not only does the angle which the visual lines make with each other change, according as we observe near or distant objects, but also when the eyes are turned outwards, upwards or downwards, the visual lines pass near and even beyond the edges ot the glasses, thus causing confusion and indistinctness of vision.

Hence, it will be seen that it is only when the movements of the head and the movements of the eyes are equal, and in the same direction, that the most perfect and satisfactory aid is obtained from Spectacles.

CHAPTER VIII.

THE ADJUSTMENT OF SPECTACLES FOR HYPERMETROPIA CONCLUDED; THEIR USE OFTEN NOT EASY AT FIRST; HYPERMETROPIA OFTEN A CAUSE OF "STUPIDITY" IN CHILDREN; THE USE OF SPECTACLES BY CHILDREN.

Eyes that are unused to the wearing of convex glasses must often become accustomed to them in more respects than one, before the effects of the new conditions, consequent upon their use, will seem real and agreeable.

At first, objects will often appear magnified and beyond their usual distances.

We learn to judge of the distance and size of objects by the amount of effort required in the accommodation and the convergence of the eyes while viewing such objects. The association between the functions of accommodation and convergence is constant. Convex glasses placed in front of hypermetropic eyes cause the accommodation to relax; a certain degree of convergence has always been associated with some given degree of accommodation, hence the patient at once associates with the relaxed state of accommodation, a certain increase in the size and distance of objects. Objects often seem to recede, and in walking, the floor or pavement

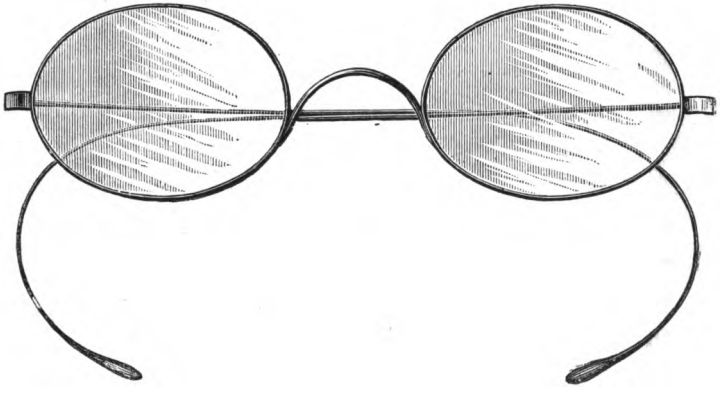


FIG. XXIII.

A style of steel-framed lenses well adapted to children, or young persons. The riding bows ensure their easy adaptation and firm position.

For persons narrow between the eyes, especially when Pulpit-Glasses (See Fig. VIII.) are desired, they are sometimes especially useful.

seems farther away than natural, and the patient feels as though he were constantly stepping to a lower level. These false impressions are soon overcome, however, and the estimation of distances and sizes becomes so natural and connected as to meet the new conditions.

It has already been mentioned that late in life hypermetropic eyes (and in fact all eyes) become presbyopic, and cannot exert the accommodation necessary for reading and fine work; therefore stronger glasses are required for such purposes, while those glasses to which the patient has already become accustomed, remain good for distance. A patient with hypermetropia of two dioptries, and wearing lenses of sufficient strength to correct it, would, in the ordinary course of events, at the age of forty-five, have presbyopia amounting to about one dioptry. He would therefore require, for near vision, the addition of one dioptry to the strength of his lenses, making the lenses three instead of two dioptries.

Aphakial eyes are those from which the crystalline lens has been removed, perhaps for the cure of cataract, perhaps by absorption after an injury. It is scarcely necessary to observe that such eyes are, with extremely rare exceptions, intensely hypermetropic, and destitute of all accommodative power. For such eyes, lenses of great strength are required to render vision distinct.

Those from two to two and one-half inches focal length will usually be required for near vision, and those from three to four inches focal length for distance. These lenses can be set in almost any spectacle frame desired. It is well to select one of the stronger kinds. Such lenses are generally known as "Cataract glasses."

Of course, owing to their great convexity, the lenses are very heavy, unless made small. Such being the case, special contrivances have been devised for reducing their size and weight.

Owing to the great prevalence of hypermetropia at the present day, and the consequent suffering entailed upon so many persons by the want of knowledge of its nature and consequences, it is of the utmost importance that physicians, at least, should become familiar with its more prominent subjective as well as objective symptoms. A moderate degree of intelligence upon this subject will prevent many and grave mistakes.

When a child is taken from school complaining of headache and fatigue of the eyes, and, in addition perhaps charged with stupidity and punished for idleness, it is neither wise nor kind for the physician to advise in every case, "Change of occupation, abstinence from study, etc." Nor does the child need the additional infliction of powerful medicines for an imaginary nervous trouble. Such a course is not wise, because a pair of

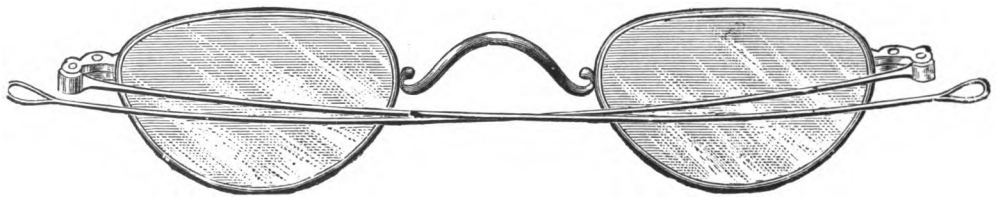


FIG. XXIV.

A style of straight temple, gold-framed, Pulpit Spectacles. Preferred by some presbyopes on account of this peculiar shape of the lenses, the upper part being cut away to permit of vision over them. These peculiar-shaped lenses can be set in frames made of any kind of metal,

properly fitting lenses will often remove the headache and the fatigue, and will perhaps restore the child to the ranks of the brightest and the most studious of his companions. Such a course is not kind because, too often, it blights the brightest prospects of developing maturity.

Were there no other moral obligations to be considered, man's responsibility to his fellow-man should be sufficient to teach us, as physicians, to fit ourselves to recognize what these cases may require and to advise accordingly.

Teachers in public schools should never be ignorant of the nature and effects of hypermetropia; for, by proper and timely advice to parents, they may be the means of relieving some of their pupils of much suffering.

One of the most common results of hypermetropia is convergent squint, or cross-eye. At about the age of five or six years, children are usually put to school and there required to read and write, and to otherwise use their eyes for fixing small objects more or less distinctly and continuously. This is the time when convergent squint most often makes its appearance. The explanation of this fact need not be added here, but it is proper to remark that the timely use of convex Spectacles may, in very many cases, prevent this condition.

Without doubt, it will be no easy matter to compel a child who is under six years of age to wear Spectacles; and too many parents have neither the faculty nor the inclination to see that the prescription of such Spectacles is faithfully carried into effect. Again, some children are exceedingly tractable and submit to the wearing of glasses, even at a very early age, while other children cannot be made to tolerate them, even for a few moments at a time, notwithstanding the most patient and well-directed efforts on the part of those in charge of them. Reasoning and kindness go a great ways in this process; when these fail, judicious shaming in the way of strong appeals to personal pride, generally succeeds.

CHAPTER IX.

THE ADJUSTMENT OF LENSES FOR MYOPIA; THE WEAKEST THAT ARE REQUIRED ARE THE BEST; THE PRINCIPLE UPON WHICH THE TREATMENT OF MYOPIA DEPENDS; SLIGHT DEGREES OVERCOME BY OLD-SIGHT; SPASM OF THE CILIARY MUSCLE; RAPIDLY ADVANCING MYOPIA SHOULD EXCITE SUSPICION OF THIS TROUBLE.

The patient should be seated as directed in the chapter on hypermetropia, that is, at twenty feet from No. 20. If now he sees neither the letters distinctly according to their numbers, nor do convex glasses of any power improve his vision, myopia may be suspected to be present. Place in front of his eye a minus 36 inches lens; if this improves his vision and brings to his view a smaller set of letters than he could before see, change to a stronger concave lens, and so on until he reads No. 20. The weakest lens with which he can read No. 20 easily, will be the measure of his myopia (no spasm of the ciliary muscle being present). But if no glass be found which permits him to do this, he may be amblyopic or astigmatic and require medical or other aid. But owing to the complications which may exist and render vision otherwise defective, cases of myopia must

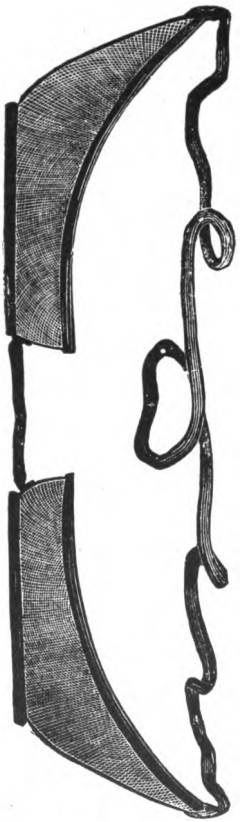


FIG. XXV.

One of the common styles of Goggles, alluded to on page 28.

not always be expected to be brought to a normal standard of vision for all distances.

In regard to the choice of Spectacles, it is hard to give anything like arbitrary rules, since so many complications are met in individual cases. In high degrees, weaker glasses for near and stronger for far vision are usually given. In moderate cases (those of three dioptries or less) one pair of Spectacles will often subserve both purposes, and should be constantly worn.

For far vision in any case, the glasses chosen should be the weakest which render distant objects most distinctly visible. These same glasses would answer for near vision (reading etc.,) were it not for the diminished power of accommodation, so common in myopic eyes. This is the result of disuse of the accommodative apparatus, and consequent weakness. Therefore when either one or two pairs of glasses are required, those which fully correct the myopia, and no stronger ones, should be given for distant vision.

The strength of the glasses to be used for near vision in any given case, must depend much upon the state of the patient's accommodation. If the accommodation is good and the myopia does not exceed five or six dioptries, a patient can sometimes, without inconvenience, wear lenses which nearly but do not quite correct the defect. But the stronger the lenses used

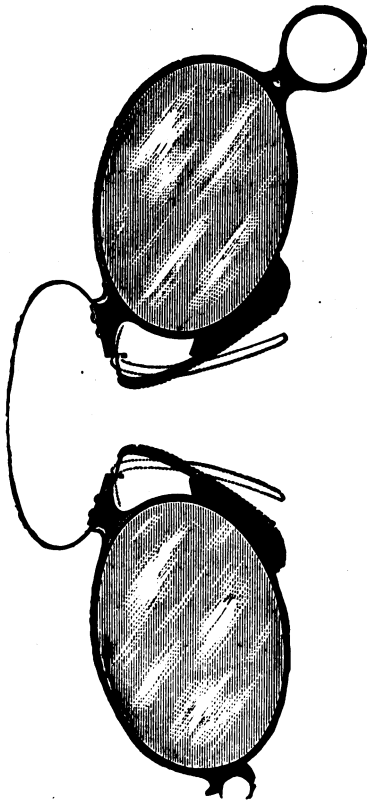


FIG. XXVI.

Hard-rubber frames, with patent self-adjusting rubber clips.

the smaller will be the retinal images and the greater the strain upon the accommodation.

The treatment of myopia, by the use of concave lenses, depends upon the principle that carrying objects farther from the eye does away with an excessive amount of convergence which overtasks the eyes, and increases and perpetuates the trouble. This fact should be impressed upon the minds of patients, or the most carefully adapted glasses will often fail to accomplish their purpose; for habits once formed are hard to overcome, and the habit of bringing the work very near the eyes, unless due care is exercised by the patient, will often be persisted in after the glasses are given. This matter needs especial attention in the cases of children; for in them the disease is especially apt to increase.

As the chief object in using glasses at all for near vision, is to remove the far point to a convenient distance for reading and fine work, (thus preventing straining of the eyes by unnecessary convergence), let us see how this may be accomplished.

Suppose a patient has a myopia of five dioptries; his far point is at about 8 inches. We wish to remove it to a convenient distance for reading. A myopia of three dioptries has the far point at about thirteen inches; a myopia of two and one-half dioptries has the far point

at about sixteen inches, and either distance is convenient for reading. We therefore give lenses which reduce the myopia to either 3 or 2.5 dioptries. A lens of 2 dioptries will accomplish the first, a lens of 2.5 dioptries will accomplish the second.

In slight cases of myopia, (1.5 dioptries or less) the only inconvenience experienced is in not seeing distant objects distinctly; so if the patient does not unconciously, or through ignorance of the effect, bring his work too near his eyes, he will suffer very little inconvenience, and may prefer to use no glasses at all. Children need especial care in regard to this matter of holding the work too near, for the defect is not only aggravated by it, but often created in perfectly normal eyes. Children in whom myopia exists to quite a degree are often unjustly punished, through the ignorance of parents or teachers, for a habit for which they are in no wise responsible. Until his vision has been properly tested, a child should never be corrected for holding his work too near.

Slight degrees of the affection may not only be overcome by advancing presbyopia, but the latter sometimes removes the near point to such a distance, that convex glasses may be required for reading and concave for distance. In most cases it will be found that, owing to the addition of presbyopia, the concave glasses may be

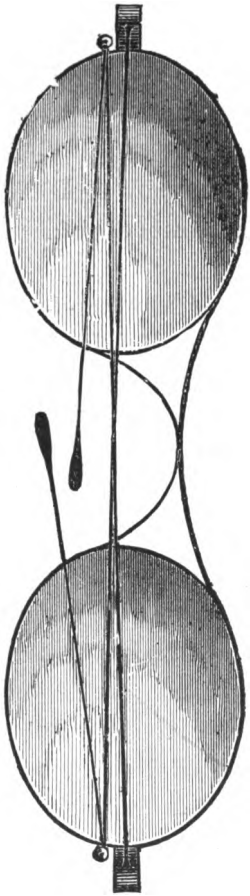


FIG. XXVII.

The common curved-glass, blue coquille, referred to on page 28. It more commonly has straight frames and bows.

replaced by weaker ones, and sometimes laid aside altogether.

The remarks concerning the centering of the lenses under hypermetropia, are quite as applicable to myopia. The visual lines should pass through the axes of the lenses, and, for this reason, the Spectacles for near vision, owing to the convergence of the visual lines, should have their axes nearer together than those used for far vision.

Spasm of the ciliary muscle occurs in hypermetropia or myopia. When due to hypermetropia it occurs in young people most frequently. While their eyes appear myopic and concave glasses improve vision, the use of the ophthalmoscope, or paralysis of the accommodation with atropine, reveals hypermetropia. The state of the refraction in such eyes is also variable, causing one power of lenses to fit at one time and another power at another. But the strength of the lenses which render vision normal at any time, is much less than the apparent degree of the myopia would seem to indicate. Such cases require careful medical treatment.

Cases of myopia which increase rapidly, should excite suspicion of spasm of the ciliary muscle, especially if they are accompanied by marked symptoms of asthenopia on using the eyes for reading, or for near work.

CHAPTER X.

THE ADJUSTMENT OF LENSES FOR MYOPIA CONCLUDED; INSUFFICIENCY OF THE INTERNAL RECTI MUSCLES; ACTION OF PRISMS; REASONS WHY GLASSES DO NOT ALWAYS BENEFIT IN THIS TROUBLE; CAUSES AND PREVALENCE OF THIS TROUBLE IN THIS AND OTHER COUNTRIES.

One of the various complications, which often accompanies and is dependent upon myopia, is insufficiency of the internal recti muscles, whose function it is to draw the eye inwards. This affection is most common in myopia of high degree, though it may be present in almost any grade. The cause is to be found in the overwork of the internal recti muscles, while producing the excessive convergence of the visual lines necessary for near vision. The muscles become fatigued after continued exercise in reading, and one eye finally rolls outwards.

The subjective symptoms of which the patient complains, are heat, pain, fullness and pressure in and about the eyes, with dimness and confusion of vision. These disappear after resting the eyes awhile, only to be renewed as work is resumed.

On examination the eyes may appear normal, but if

FIG. XXVIII.

A style of Spectacles made to be worn by Surgeons while operating. The lenses are plane and white; 1¼ inches in diameter.

we hold a pencil, or some similar object vertically in front of the patient's eyes, and, while he continues to look steadily at the object, gradually carry it towards his eyes, we shall find that when the object is within five or six inches of the patient, one eye becomes unsteady and rolls outwards. This outward deviation may be gradual or sudden.

But perhaps the best method of detecting this affection is by means of prisms. Hold a prism in front of one of the eyes under examination, with its base either upwards or downwards, and double images will be produced, with lateral displacement of these images. That is, one image will appear above the other and to one side. In the normal, or emmetropic eye, the prism would simply have the effect of causing the images to appear double, one image being directly above but not to one side of the other.

A white card, with a dot in the middle of a vertical line, is a convenient object for the patient to observe while undergoing the test. He should fix his eyes upon the dot and then note the effect.

The strength of the prism required to fuse the two images, is the measure of the insufficiency.

In order to treat these cases intelligently, the practitioner must not only be able to exclude cases of insufficiency of the internal recti muscles due to other causes

than myopia, but he must also provide himself with a set of prisms and the appropriate frames for adjusting them. Some cases are greatly benefitted, and others are completely relieved, by the wearing of proper prismatic glasses. The prisms are placed in the spectacle frames, bases inwards, and combined with the proper concave lenses; or, what is better, the concave lenses may be ground into the prisms.

The action of the prisms is to deflect rays of light inwards towards their bases; therefore, rays from near points, on passing through them, enter the eyes as though they came from greater distances. This disposes of the excessive convergence of the optic axes. The relations between accommodation and convergence of the eyes has already been referred to under hypermetropia. The proper concave lenses relieve the accommodation, the proper prisms (bases inwards) relieve the convergence; to so adjust and combine the two, that these functions shall remain in harmony, requires care and an experimental knowledge of the subject; to fully elucidate it, by words, is difficult. Experience is the best teacher.

With the best possible adaptation of glasses, the vision of many myopic eyes is but little improved, especially for distant objects. This fact is susceptible of explanation in various ways; but perhaps the most constant and

FIG. XXIX.

A gold frame, ornamented with faceted work, presenting a particularly genteel and elegant appearance.

potent cause is to be found in the fact that the perceptive elements of the retina are spread over a larger space in the myopic than in the emmetropic eye. Furthermore, concave glasses, while they bring parallel rays to a focus at their proper place upon the retina, and thus make the image distinct, also diminish the size of the images so much, that sometimes little advantage is gained.

Many persons affected with myopia, refuse to wear glasses in the hope that, with the advance of age, they may have no need for them. Such a course is not to be commended, for not only is the affection more apt to increase thereby, but these persons constantly undergo much unnecessary discomfort.

When two pairs of glasses are given to one person, explicit directions should be given regarding their use, and the patient should be especially warned against attempting to use the stronger glasses for near vision. It is a question whether considerable harm is not caused by the thoughtless observation of near objects while the stronger glasses are in use. The stronger glasses are simply intended to contribute to the comfort of persons wearing them, permitting them to see at a distance; the weaker glasses are intended to prevent the progress of the affection. The latter should not be laid aside while engaged in reading or near work.

In conclusion of the subject of the adjustment of

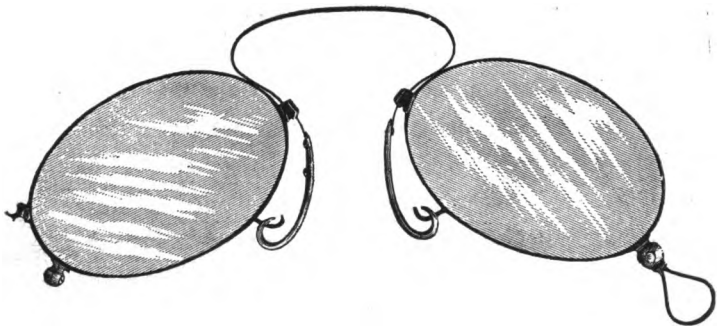


FIG. XXX.

Steel-framed eye-glasses, French modeled clips.

Spectacles for myopia, it will be interesting to note some of the causes and the relative prevalence of this disease; for myopia, without question, is often a disease.

Cohn, of Germany, some years ago published a monograph upon this subject, giving the results of actual examinations upon 10,060 school children. He found that the affection increased in proportion as the school-rooms were poorly lighted, or the desks badly constructed. Of the 10,060 children examined 1,004 were myopic. The elementary scholars were less frequently affected, and the number of cases increased as the grade of the school was higher.

That the disease was an acquired one, is shown by the fact that out of all these children, only 28 had myopic parents.

According to the experience of Donders, who made extensive observations in Europe, myopia is much more prevalent in Germany than elsewhere. Angell attributes this fact to the peculiar type in which the German text is printed; while to confute this supposition, the report made by Liebold in 1877 may be cited. This report shows that among 600 girls in a grammar school of New York, 53 were myopic, 459 hypermetropic, 59 astigmatic and hypermetropic, and only 23 were emmetropic. The ages of these scholars ranged from eight to eighteen years. Such a report, if confirmed by others

of a similar nature, would seem to prove that the people of the United States are far from being able to claim any special exemption from the affection.

The higher and better educated classes of society show a much larger percentage of myopia than is found among people in the lower walks of life. In the Eastern and Middle states it is much more common than in the Western; and Fenner says "The great number of persons wearing concave glasses in Boston, is a subject of remark with many Southern and Western visitors to that city, and is often attributed to a *desire to appear fashionable.*"

Out of the 10,060 children examined by Dr. Cohn, only 107 wore Spectacles, and 99 of these had selected them themselves. Only 11 wore Spectacles which were not injurious to the eyes. Such facts need little comment; for the injurious effects of a haphazard plan of selecting Spectacles is too plainly evident.

In furtherance of the theory that myopia is acquired, and not congenital as a rule, Mr. Macnamara, a distinguished British surgeon resident in India, says: "It is remarkable how few cases of impaired vision, due to anomalies in the refraction and accommodation of the eye, are met with among the lower classes in India. In fact, whole races of people appear to actually be strangers to these diseases. For instance, some years ago I was among

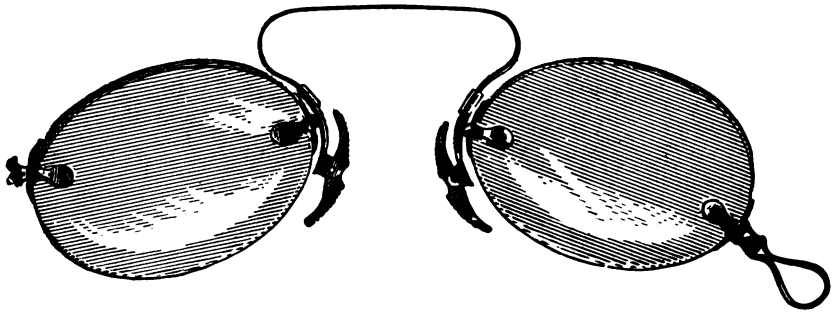


FIG. XXXI.

Lenses with the attachments made directly to them, and known as "Frameless Eye-glasses." Being without frames, the lenses must be made of a heavy glass, or pebble, to admit of a secure fastening. Hence, the peculiar clips are advantageous in preventing their slipping.

the Sonthals, the aborigines of Bengal, dwelling in the Rajahmahal hills, and I took every opportunity of examining the eyes of the people I was brought in contact with, for the purpose of discovering if myopia and such like diseases existed among them; but I never yet saw a young Sonthal whose eyes were not emmetropic; the same remarks apply to nearly the whole of the lower classes in Bengal, with the exception of those living in Calcutta and other large towns, where overwork, sensual indulgence, and a polluted atmosphere have done a vast deal of harm to the physical, as well as the moral eyes of the inhabitants."

CHAPTER XI.

THE ADJUSTMENT OF GLASSES FOR PRESBYOPIA; CHANGES IN THE EYE DUE TO AGE; RECESSION OF THE NEAR POINT; THE CALCULATIONS REQUIRED; PRESBYOPES SHOULD HAVE ABUNDANT AID; GENERAL PRINCIPLES FOR THE TREATMENT; DANGERS OF ERROR.

The nearest point of distinct vision begins to recede at a very early period of life. A child, at the age of ten years, can usually thread a small-eyed needle held at a distance of two and three-quarters inches from the eye; at the age of fifteen years, the near point has receded to about three and a quarter inches; at twenty, it has gone to about three and three-quarters inches; at thirty, to about four and a half inches; at forty, to about nine inches; at forty-five, to about twelve inches; at fifty to about eighteen inches; at fifty-five, to about twenty-two inches; at sixty, from thirty to thirty-six inches; at eighty, there is no distinct vision without glasses. As a rule, a young person who sees as well, or better, with his mother's or grandmother's glasses, is hypermetropic.

Other changes also take place in the eye as age comes on. There is a loss of the transparency of the media,

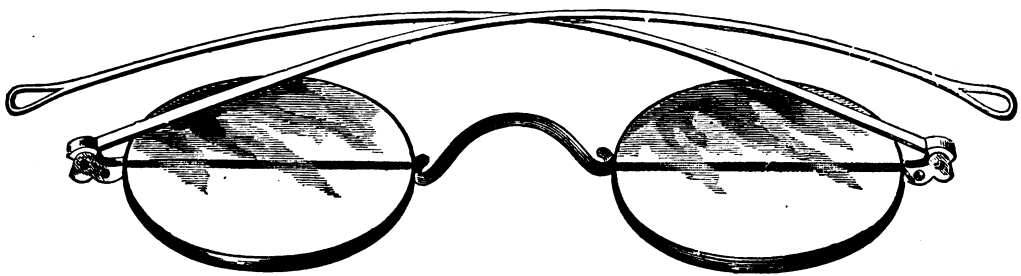


FIG. XXXII.

Coin silver frames with "Split lenses," or "Franklin glasses." It is a matter of taste, generally, as to whether the different powers shall be ground on a single piece of glass, or two half-lenses be placed together. Sometimes they are ground on one piece in more fanciful shapes, as the upper half with a shorter radius than the lower half, etc., presenting a very genteel appearance.

which though gradual, is yet so steadily progressive that oculists are able to closely estimate the age of a person by this change alone. The entire construction of the eye also undergoes changes not necessary to enumerate in this connection. The practical results of these are, decrease in the refraction of the eye and shortening of the range of the accommodation.

I shall not discuss these matters, since, for the purposes of this subject, we may regard the recession of the near point beyond 8 inches in emmetropic eyes, as the beginning of presbyopia. By means of convex Spectacles, the near point is restored to its normal distance and the overtasked accommodation relieved. In uncomplicated presbyopia, the patient can generally read No. 20 of the test types at 20 feet, but he cannot see small objects well. Ordinary fine print cannot be distinguished at the former distances of 8 inches and less, but it must be carried farther from the eye. The accommodation is evidently at fault, and rays from near objects are not focussed upon the retina.

In the beginning of presbyopia, when the near point has not receded beyond 9 or 10 inches, very weak glasses will supply the deficiency in the accommodation, and will need to be worn only in the evening and by artificial light. It is not well to begin with too strong glasses, for they hasten rather than retard the difficulty.

If the near point has receded to 9 inches, and we wish to restore it to its original distance of 8 inches or less, the lens necessary to do this may be found as follows: 1-8—1-9=1-72, which shows that a lens of 72 inches focal length (about a plus .5 dioptry) is required to supply the deficiency in accommodation. If the near point is at 12 inches, then 1-8—1-12=1-24. If the near point is at 16 inches, then 1-8—1-16=1-16, and so on: or in other words, a 24 inches convex lens (about a plus 1.5 dioptries) will supply the first case, and a 16 inches convex lens (about a plus 2.5 dioptries), will supply the second.

Inasmuch as presbyopia can be neutralized by convex glasses, and that failing to use them when indicated will sooner or later cause asthenopic symptoms, we should insist that those suffering from this defect wear glasses. The weakest convex-lens which will enable them without fatigue to read No. 1 of Snellen's test-types at from eight to twelve inches from the eye, are the correct ones. In the greatest number of cases, plus 36 to plus 40 will be quite strong enough in the beginning; an increased power will be required as age comes on. In some cases it will be better to begin with plus 72, or a number but little stronger.

If, in addition to the presbyopia, the patient is amblyopic, glasses will not improve the vision much, if at

all. It should not be forgotton that the perceptive power of the retina diminishes as age increases, thus causing a defect in the visual apparatus which lenses cannot remedy.

Care should be observed to note that the patient has abundant aid. Many will endeavor to conceal their "infirmity," as they often call it, through false motives of pride, hoping thus to retain a baseless reputation for juvenility. Cataract and glaucoma, I believe, may often find their cause in the strain put upon aged eyes by improperly fitting glasses.

It should be remembered that the object of the convex lenses, except in extreme old age, is not to magnify the retinal images, but to bring back the near point of distinct vision to a convenient distance, thus making the images distinct and of the same size as before; furthermore, glasses adapted for near vision are not suitable for far sight, their use for such being often injurious.

Fig. XXXIII.

The many devices whereby the lens of the eye is temporarily made more elastic, are in no wise to be recommended. Their after affects are often painful and destructive of good sight.

The general principles on which to treat presbyopia are to recognize it early, and to supply abundant optical

It is quite impossible to determine an exact standard of vision for what is called a normal eye. As is well known, no eye is perfect. But by careful experimenting, I have found that print of this size should be easily read in a good light. by what may be called a perfect eye, at a distance of from four to four and

one-half feet, while print of this size may be easily read, under similar conditions, at from five to five and one-half feet. To secure a good illumination, the patient should sit with his back to the light.

Type of this size, however, under favorable conditions, should be read at a distance of about seven feet; and

when this size is used, good vision should be attained at a distance of about fifteen feet.

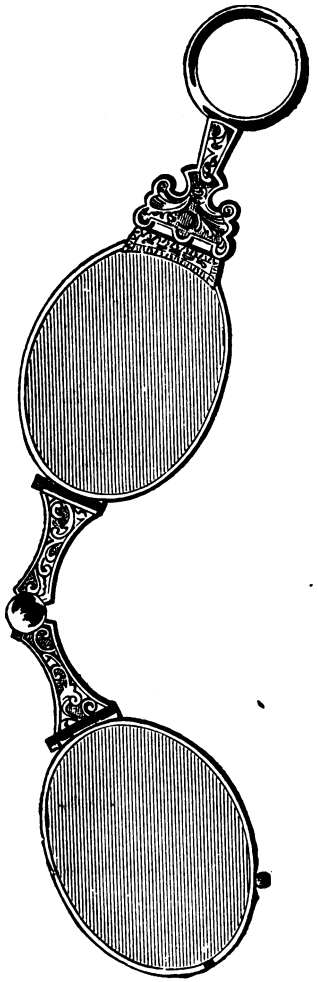


FIG. XXXIV.

Gold folding eye-glasses, suitable for ladies desiring a stylish and convenient bow.

aid. If the glasses fail to relieve, a more careful consideration of the convergent muscles must be made, and such Spectacles as are described in the next chapter, the orthoscopic, may be required. I have not entered into their discussion, because they require a somewhat comprehensive knowledge of the subject of the whole eye, and information must be sought from larger works, or from some oculist.

While the dangers of carelessly choosing one's own Spectacles are perhaps at the minimum in presbyopia, it must never be forgotten that a rapid increase of this trouble is one of the premonitory symptoms of that little understood, but terrible trouble, glaucoma. For this reason, and lest glasses be erroneously ordered for anyone who applies for them by reason of suspected advancing "old-sight," all eyes should be carefully examined for glaucomatous symptoms, prominent among which are increase of tension, diminution of the acuteness of vision, limitation of the visual field, etc. Mention has already been made of a case where entire loss of sight was due to this error. In nearly every case of this kind, the remark is made that no doctor had ever before suggested any danger, though several had been consulted.

CHAPTER XII.

SPECTACLES FOR IRREGULAR SIGHT; STENOPÆIC SPECTACLES; ORTHOSCOPIC SPECTACLES; SUBMARINE SPECTACLES; FORMS OF OCULISTS' PRESCRIPTIONS.

A considerable number of cases of defective sight will be found that cannot be fitted by any of the foregoing rules, which however, are not to be classed by the statement made at the end of Chapter VI. Among such may be found eyes known as astigmatic. The astigmatism may be separate from, or co-existent with myopia, hypermetropia, or emmetropia (normal refraction) in the same eye. The companion eye may be emmetropic or not.

This subject of Astigmatism was briefly alluded to in Chapter I. Before proceeding to consider the methods of correction of this anomaly by lenses, the nature of the defect, and its varieties, need further description.

That astigmatism is a defective state of the vision due to a lack of symmetry between the different meridians of the refracting surfaces, has been stated. This asymmetry or irregular curvature, may be found in the cornea or in the crystalline lens. The principal meridians of the cornea are those of the greatest and the least curva-

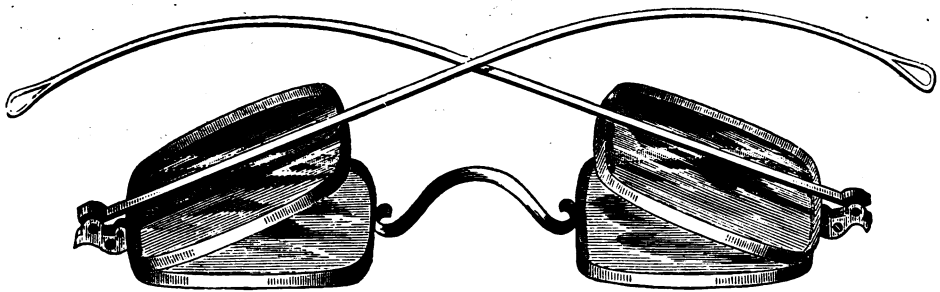


FIG. XXXV.

Gold Spectacles, with colored-glass side-light protectors. Preferred by some on account of their excluding the rays of reflected light. The protectors may be of any colored glass desirable.

ture. These two meridians are always at right angles to each other, and usually one is horizontal and the other vertical. Sometimes they lie obliquely.

The two chief divisions are regular and irregular astigmatism. Different focal lengths of principal meridians cause regular astigmatism; differences of refraction in the same meridian cause irregular astigmatism. The varieties of the regular form are several, the degrees are almost innumerable. A patient with one meridian emmetropic, and the meridian at a right angle to it myopic, has simple myopic astigmatism; or if the one meridian be emmetropic, and the one at a right angle hypermetropic, he has simple hypermetropic astigmatism. Hypermetropia in both principal meridians, but differing in degree, constitutes compound hypermetropic astigmatism; myopia in both principal meridians, but differing in degree, constitutes compound myopic astigmatism. Finally, if a patient has myopia in one principal meridian, and hypermetropia in the other, he has mixed astigmatism.

Regular astigmatism is usually a congenital hereditary defect, while irregular astigmatism is more apt to be acquired. The former is amenable to treatment by lenses, the latter is seldom much benefited by any treatment.

The methods of testing and measuring astigmatism

are very numerous, and, as in the other forms of ametropia, may be either subjective or objective. The difference between these latter methods has been explained in a preceding chapter.

All subjective tests depend upon the fact that if the astigmatic eye looks at a number of lines of uniform width, drawn in different directions, some will appear clear, and others more or less indistinct. The lines used for this purpose should be clear, sharply defined, and not too narrow. *

The normal eye is said to be slightly astigmatic, but if the difference is less than 1-40th of an inch, it causes no appreciable disturbance of vision.

The kind of lens necessary to correct this defect has been already mentioned. All lenses for the correction of ordinary errors of refraction are segments of spheres; those for astigmatism often combine two kinds, the spherical and the cylindrical. Sometimes the latter is sufficient. A cylindrical lens is the longitudinal section of a cylinder, and may be either convex or concave according to the portion of the cylinder it is taken from. It may also be either plano-convex or plano-concave, bi-convex or bi-concave, a positive or negative

* Diagrams for this purpose may be obtained at any medical bookseller's. The collection known as Green's Astigmatic Tests are among the best. (Price, $5.00). Pray's Astigmatic Letters are also useful.

meniscus. When a cylindrical lens is combined with a spherical lens, the resulting lens is termed sphero-cylindrical. This lens is made with one side ground spherical and the other cylindrical.

Simple astigmatism is corrected by a cylindrical lens, while compound astigmatism requires a combination of the two kinds. Success in treating astigmatism lies in removing the difference between the two meridians by a cylindrical lens appropriate to such difference; the spherical lens equalling the ametropia still remaining will then enable the rays of light to impinge sharply on the retina, and the anomaly will be corrected. A little reflection will show that it is sometimes a question of judgment as to whether it is better to correct the anomaly as apparent, or by a suitable cylindrical lens, create the opposite one, and then relieve that by its suitable lens.

Rays of light falling on the plane of the meridian passing through the axis of a cylindrical lens, do not change their direction, there being no refraction in this meridian. In all other meridians, however, the light is refracted, but in degrees, increasing as the meridian is more nearly perpendicular to the axis of the cylinder. In the perpendicular meridian, the highest degree of refraction is obtained.

Similar differences of refractive power taking place

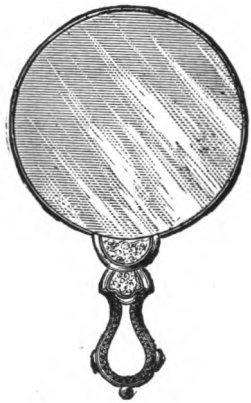


FIG. XXXVI.

Monocle, or quizzing glass. Not much used in this country. Not recommended on account of the disuse of the companion eye tending to weaken it.

in the astigmatic eye between the least and the greatest deviating (principal) meridians, it follows mechanically that if a glass of the cylindrical form compensating for the deviation in any meridian, be placed in front of such meridian, the eye will be in a correct state of refraction.

The solving of the optical problems presented by these various forms of astigmatism, especially when they are combined with failing powers of accommodation, etc., while not difficult, is of such seeming intricacy that it is seldom ventured upon by one who is not familiar with the whole subject of the anomalies of refraction and accommodation.

It is no uncommon thing, for one who has not seen well, to find, on consulting an oculist, that the whole cause of his deficient sight is a trouble like one of those which have just been mentioned, and one which might have been corrected, and the whole defect removed, years before. Eyes not infrequently become astigmatic after cataract operations; sometimes after any affection requiring a cutting of the cornea to any considerable extent.

Stenopæic Spectacles and Stenopæic Apparatus, are terms applied to contrivances designed to improve the vision in some special forms of eye trouble. By another application of the same principle, they shut out

intense transmitted and reflected light, as in the snow-bound arctic regions, and thus avert injury to the sight by preventing damage to the retina.

Corneal opacities are seldom so dense as to shut off, by reflection or absorption, all of the rays which meet them on the way to the retina. A clear portion of the cornea, in the line of vision, allows all the rays which reach it to pass uninteruptedly to the retina, there to form a distinct image of any external object; but the part of the cornea rendered translucent by an opacity, transmits a sort of diffuse light. The latter acts as a veil, or hazy obscuration, to the images on the retina. One office of Stenopæic Spectacles is to limit the field of vision to a clear portion of the refracting media, and to prevent light from reaching the corneal opacities. The light is made to pass through a comparatively small opening in some opaque substance, such opening being made to conform somewhat to the shape of the clearest space in the line of the pupil. This opening is often in the form of a narrow slit; it may be oval, or round, according as the best result is produced. Oculists are provided with different forms of this apparatus, and are enabled, by their application, to determine whether particular forms of defective vision can be improved. Numerous ingenious appliances have been devised for this purpose, and have been found useful

in some forms of astigmatism, and in high degrees of myopia, etc. In all cases the opening which admits the light should be as near the eye as possible.

A simple way of making Stenopæic Spectacles is to blacken the glass worn in an ordinary spectacle frame, leaving only a small clear space to correspond to the clear portion of the cornea in front of the pupil. The glass worn in the spectacle frame may be plane or lens-shaped, according to the requirements of individual cases. It is sometimes necessary to make an iridectomy, to permit them to be worn to advantage. On the other hand, an iridectomy well-made often renders the stenopæic apparatus no longer necessary.

Orthoscopic Spectacles is a term applied to a kind consisting of lenses with a spherical surface on one side and a prismatic surface on the other. The spherical surfaces remove all need for the exercise of the accommodation, and the prismatic surfaces do away with the necessity for convergence. When properly adjusted, they enable one, up to a certain point, to exercise the eyes without any strain upon them. Practically, they are limited in their use, but great advantage may sometimes be obtained from them.

The uses of Prismatic Spectacles have been alluded to frequently in the course of descriptions of other kinds. A special study may be made of them with advantage.

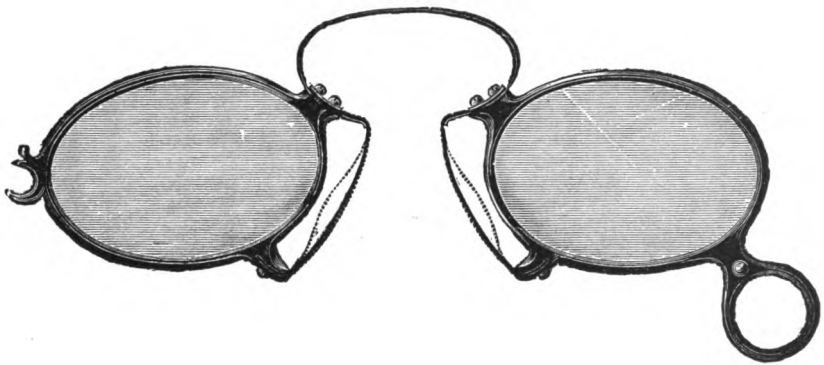


FIG. XXXVII.

A tortoise-shell frame, with peculiar self-adjusting whalebone clips. These clips admit of an adjustment not obtainable by those of a firmer nature.

Such study, as well as a much more extended one of the various kinds used for astigmatism will be a necessity for those who desire to master the highest branches of the adjustment of Spectacles.

My venerable friend, Dr. R. E. Dudgeon, of London, England, in his work entitled "The Human Eye; its Optical Construction," explains a device of his own for seeing under water. As is well known, the eye alone does not enable a person to see well under water; to overcome this, Dr. Dudgeon has devised and constructed a pair of Spectacles that restore the refraction to the same extent that exists before the eye is immersed in this fluid.

When in London last, I was not only fortunate enough to be honored with the presentation by the inventor of one of the original air-lenses described in the text, but of witnessing a practical demonstration of his theory of the accommodation which has given him such a high rank among scientists. It must at least, be entitled to rank with any theory concerning this subject, (though that of Helmholtz is perhaps the most generally received). For my own part, I have never been able to reconcile with either, the fact that some eyes will accommodate when the lens is removed, for the lens is essential to the successful demonstration of either theory.

Dr. Dudgeon remarks that "The sight which in reality remains to us when immersed in the clearest water is the perception of light and of color, but only the vaguest perception of form. And even this poor amount of vision only remains for objects at a small distance from us; a few yards off, even objects of considerable size are unseen.

"In order to restore perfect vision under water, we must use a lens capable of concentrating the rays of light transmitted to it through water into a focus at 1 1-2 inch behind it; this being the focus of the aqueous lens lost by immersion in the water.

"If we use a glass lens for this purpose it is obvious that it must be a much more powerful lens than what would have a focus of that length in air. For while the refractive index of air compared with that of glass is as 1 to 1.5, the refractive index of water compared with that of glass is only as 1.33 to 1.5. Hence glass will refract the rays of light to a very much smaller extent in water than in air, in fact about one-fourth. I have found experimentally that a glass lens which has a focus of three-eights of an inch in air will have a focus of 1 1-2 inch in water. Therefore a glass lens of this power will be required in order to enable an eye immersed in water to see distinctly, and I have practically proved that this is so.

"But it is obvious that water being itself a medium of high refractive power, it would be better to avail ourselves of a medium either of much greater refractive power than itself, or of much less. Now it is difficult to procure a transparent medium of much greater refractive power than glass for use in the water. Diamond, which would do, its refractive power being as high as 2.4, is for obvious reasons not to be thought of. But there is nothing to prevent us using a medium of very inferior refractive power to water in the construction of subaqueous lenses. The medium of least refractive power is air. The relation of lens medium to surrounding medium being reversed, the shape of the air lens must be also reversed, as before shown. We must here use a double concave air lens in place of the double convex glass lens.

"By taking two of the old-fashioned highly-curved watch glasses, and fixing them in a ring with their concavities outwards, we enclose a portion of air of the shape of a double concave lens. Immersed in water, this air lens will refract the rays of light from objects reaching it through the water, convergently. It will resemble in its optical properties a double convex glass lens in air, as I have explained.

"I found that a double concave air lens, made with two sections of a glass globe of 2 inches diameter, consti-

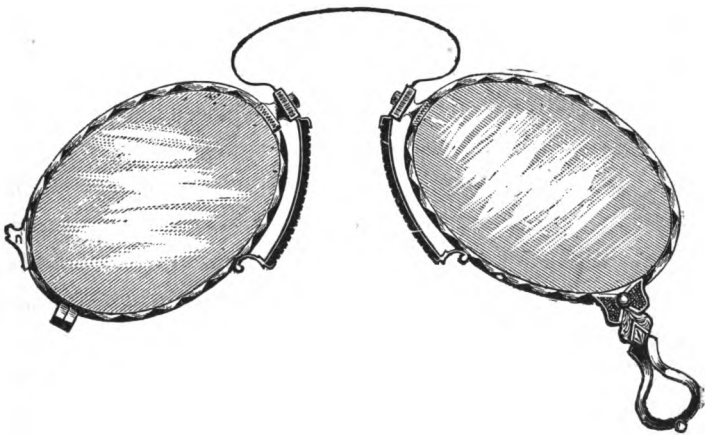


FIG. XXXVIII.

A very handsome faceted frame of gold. For those who desire a gold eye-glass, no handsomer frame can be selected.

tute a lens of 1 1-2 inch focus when immersed in water This lens accordingly supplies the refractive power lost by the eye when immersed in water.

"I thought it might be advantageous, or at all events agreeable to be able to see distinctly when diving; so I constructed a pair of Spectacles fitted with air lenses of the kind just described. It is obvious that Spectacles fitted with air lenses would be much more convenient for diving than glass lenses. For whereas the glass lenses required for subaqueous purposes are of such very short focus in air (only three-eights of an inch), that they would prevent all vision when the diver came to the surface, these air lenses would offer no impediment to perfect vision in the air, and so might continue to be worn with equal advantage both in air and water. I found, however, that the two sections of a glass globe which form the concave air lens, have in the air the effect of a very weak concave glass lens, * such a lens as is used to correct the slightest degree of short-sight. The cause of this is that the inner concave surface of the glass globe is a curve of smaller radius than the outer convex surface. Thus it is a concavo-convex lens, though of very small power. But when two such glasses are placed together the refraction they produce is appre-

*Such an effect as is produced by the common cheap blue-glasses (coquilles), as mentioned on page 28.

ciable, and somewhat impairs perfect vision to a non-myopic eye.

"In order to counteract this slight refraction in the lens when used in the air, in place of having the glasses made of sections of a glass globe, I had them ground with surfaces of precisely the same curvature. *

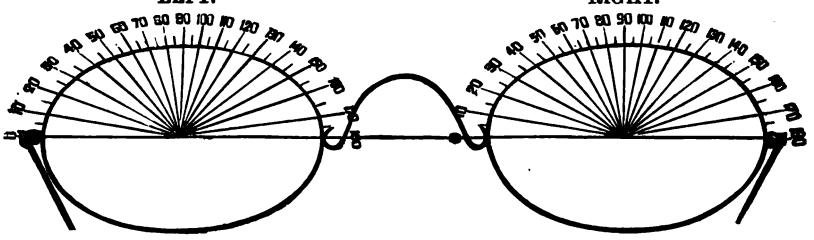
"By this means I obtained glasses for my air lenses which, having their surfaces of precisely the same curve, cause no deflection of the rays of light. These lenses therefore restore perfect vision beneath the water, and offer no impediment to perfect sight in the air."

When the oculist has made his examination of a patient, if he decides to order Spectacles, he writes a prescription as the case may demand. In this, as in a prescription to an apothecary, certain symbols are used, intelligible only to the initiated. Ordinarily a printed form is used, which the oculist fills and sends to the optician. One of these forms is given on the following page. With the exception of the radiating lines, with their corresponding numbers, as shown in the cut, the items explain themselves. The lines and numbers are intended to indicate the various degrees of inclination at which the axes of cylindrical lenses are set in spec-

*Exactly as may be done when coquilles are necessary. They are much more expensive than the pressed or molded ones, however.

..... 18.....

LEFT. RIGHT.



Spherical	*Spherical*
Cylind. *Axis:*	*Cylind.* *Axis:*
" "	" "
Prism. *Base:*	*Prism.* *Base:*

Distance between centres of pupils, ... inch.
" " temples, ... "
" from inner Canthus to Crest of nasal bone, . "
For distance? or near point?
Crown glass? or Pebble?

..... *M. D.*

To .....

.....

tacle frames. This cut, while very useful, is not essential if the directions are plainly written.

Some of the symbols in common use, with their significations, are the following: O. D. (*opticus dexter*), the right eye; O. S. (*opticus sinister*), the left eye; + positive; — negative; s., spherical; c., cylindrical; ⌒ or ⌊ combined with; = equality; + stands for a convex glass, — for a concave.

A few examples of the practical uses of symbols are as follows: + 60 s, represents a convex spherical lens of 60 inches. When no symbols are used before or after the number of the lenses, the symbols + and s. are understood. — 42 c represents a concave cylindrical glass of 42 inches.

O. D. — 36 and O. S. — 36, signify that a concave spherical lens of 36 inches is to be used for each eye. A prescription written as follows:

O. D.	O. S.
— 8 ⌒ — 24 c Axis H.	— 8 ⌒ — 30 c Axis H.

signifies that for the right eye, a concave spherical glass of 8 inches is to be used in combination with a concave cylindrical glass of 24 inches, the latter having its axis horizontal; for the left eye a similar spherical glass is to be used, but combined with a concave cylindrical one of 30 inches, axis horizontal. Some further examples from practice are:

O. D.	O. S.
— 24 c Axis V.	— 30 c Axis V.
O. D.	O. S.
+ 13 ⌒ + 30 c Axis 60 °	+ 13 ⌒ + 48 c axis 120°.
O. D.	O. S.
— 13 ⌒ 1° prism, base inward.	— 13 ⌒ 1° prism, base inward.
O. D.	O. S.
— 9	— 6½ ⌒ 5° prism, base outward.
O. D.	O. S.
— 12 ⌒ — 30 c axis 60°.	— 14 ⌒ — 36° axis 120°.

The items in the printed forms are also to be filled as essential aids to the symbols.

CHAPTER XIII.

OTHER DEVICES FOR AIDING THE ACCOMMODATIVE EFFORT; THE TYPE WRITER; THURSFIELD'S WRITING SLATE; STANDING DESKS; MEANS OF ILLUMINATION; OIL OR GAS.

In the preceding chapters, stress has frequently been laid upon the value Spectacles have in assisting the accommodation, etc. While not strictly embraced under the title of this volume, it will not only be fitting but most valuable to refer to some accompaniments especially adapted to those who are, even with the best of glasses, obliged to economize in the use of their eyes. All devices which tend to save the strength necessary to be applied in this direction, are a great boon to mankind, in that they permit many to engage, or continue, in occupations which they otherwise would be obliged to abandon altogether.

Prominent among these stands a contrivance known as *The Type-writer*. Fig. XXXIX shows this apparatus in one of its best styles. It consists essentially of a square iron frame with a key-board, containing the keys which control the letters. The latter are arranged in the order of their respective frequency in words

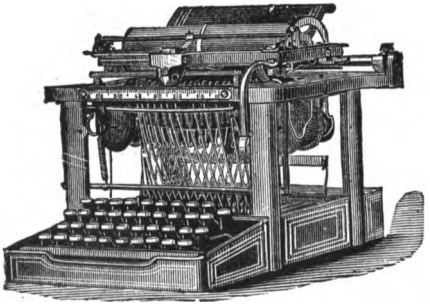


FIG. XXXIX.

The Type-Writer.

and not in alphabetical order. The whole apparatus is placed on a table. By striking the proper key, an arm containing the desired letter is immediately thrown upward, and the letter is imprinted on the paper in its correct position. Mr. Carter has so well described the invention that I quote him as far as applicable, slightly changing the wording in some minor details to make it correspond to the improved machines.* Quite large portions of intercurrent irrelevant matter have also been omitted. "Even in learning the use of the instrument, when the letters have to be looked for one by one until the fingers become sufficiently familiar with their several positions to touch them instinctively, the characters are so large that there is no appreciable strain on the vision; and, when once dexterity is attained, the eyes can scarcely be said to be used at all. My own eyes have never occasioned me any discomfort; and my own use of the type-writer rests upon quite different grounds; but yet my experience of it enables me to recommend it, very strongly, to all persons who, having to write much, are made conscious that they have eyes. For the short-sighted it is especially valuable; because there can never be any inducement to stoop over it, so that a great snare to them in writing is set aside altogether. Next only in advantage

* For sale by Messrs. E. Remington & Sons, 38 Madison street, Chicago.

to the facilities it affords for writing are those it affords for reading what has been written; for this is printed in perfectly spaced lines at regular and if desired, at rather wide intervals, in capital or small letters of perfect clearness. The author who wishes to glance back over his manuscript is almost as much helped as he who only wishes to produce it; and the labor of seeing, in every stage of the process, is either abolished or reduced to a minimum.

"I most strongly recommend the type-writer to all persons who write for considerable periods of time, more especially the short-sighted, or to those who have any trouble about their eyes.

"In using it, it is quite possible to keep the shoulders square and to sit erect; but nearly all persons who write with a pen at a low desk contract a habit of stooping, which is in many ways prejudicial to them. It not only contracts the chest, so as to interfere with the freedom of respiration and thus with the due æration of the blood; but it also tends to produce congestion of the head generally and of the eyes in particular."

My experience with the type-writer, though somewhat different, has been quite as favorable as Mr. Carter's. It did not take me so long to learn, and I naturally write so fast that I did not increase the speed as rapidly as he did. I also was very loth to take it up, being

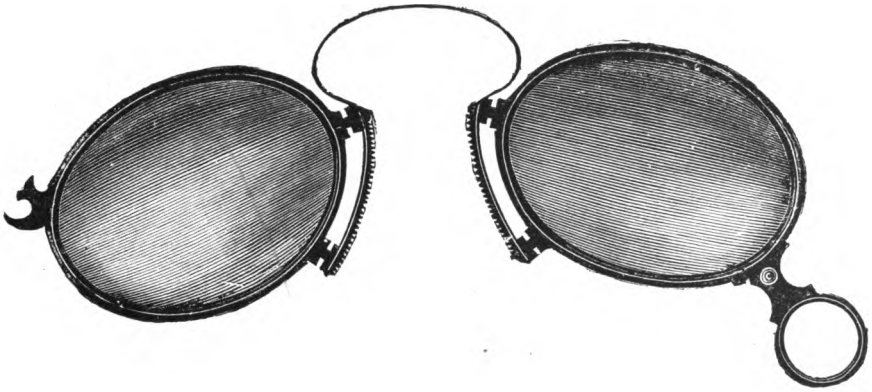


FIG. XL.

Colored coquille eye-glasses. Subject to the same criticism as the straight-temple bows, but useful under the same conditions.

naturally very conservative. But after much use of it, I must say I regret very much to have so long lost the very great aid I know it to be, for it would have saved me many weary hours of drudgery in writing, and much strain upon the eyes.

The extract just quoted has so fully covered the usually claimed advantages that any farther commendations may seem unnecessary, but I shall add that the greatest advantage I have derived from it has been in the rest to the eyes it has afforded in composing articles for the printer, and in my correspondence. I can use it as one composes on the piano, in which occupation, as an expert knows, the composer is seldom compelled to look at the keys, they being absorbed in the mental act of composition. The manuscript for this book was entirely prepared on the type-writer, and that too, with an ease and accuracy not to be attained in any other way.

From the great distress it formerly gave me to write when fatigued, or after eating, I had to come to the conclusion that I must give up this labor at such times and had in fact made arrangements tending towards an early release from such work, for all oculists know that the process of digestion often diminishes the power required to sustain the eye-sight. The relief in pos-

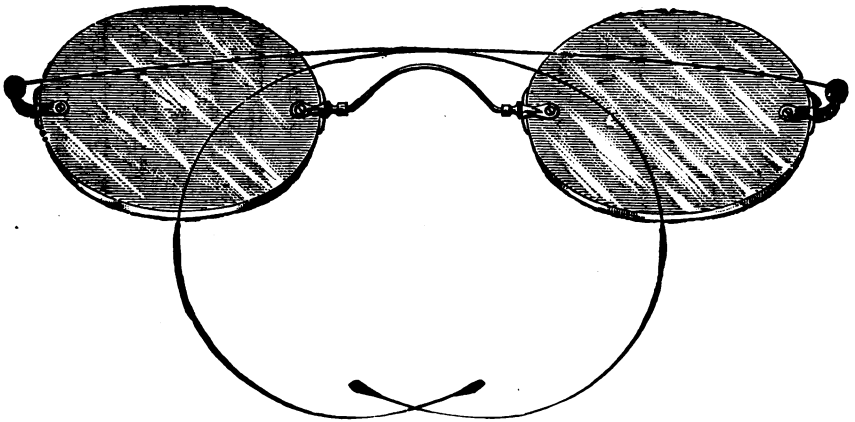


FIG. XLI.

Gold mounted "Frameless Hook Spectacles," with wide nose-rest.

All kinds of riding bow, or hook, Spectacles, can be made with what are known as short hooks. Such hooks do not curl around the ears, but are firmly made, and simply hook on to them. The catching in the hair, and the difficulty sometimes experienced in not readily taking them off, are thus in a great measure obviated.

ture afforded by this instrument, has saved me from an unwelcome change.

I was also fearful that the cramped position of the hand required in writing would impair my manual dexterity, to attain which I had sacrificed so much; for the muscles of my fingers and thumbs have often felt so stiff, hours after writing, that I was unable to use them naturally for other work. With the type-writer, however, I have written for hours at a time and then risen fresh and comfortable, a thing I cannot say ever occurred after a similar use of the pen. Therefore I commend it highly as an agreeable relief in literary labors, and as an aid in saving and preserving the eyesight.

Another device deserving mention is what is known as *Thursfield's Writing Slate.* The object of this device is to enable one to write in the dark, or without the use of the eyes; it accomplishes its purpose admirably. It is essentially a flat surface, which may be held in the lap or placed upon the table, with a horizontal bar to guide and support the hand. When the end of the line is reached, the bar drops, by an automatic movement, so as to bring the next line into proper position.

After a little practice, its use becomes easy, and a greater or less degree of speed is attained. This may be kept up without the aid of sight. Thus the machine is equally useful in the railway carriage for those who

are compelled to economize their time while on a journey; to those who are unable to sleep at night and desire to pass the time in an agreeable manner, without injuring their eyes, as they are extremely liable to do reading in bed, or by a continuous use night after night even though they occupy a better position; to the blind who desire to continue an occupation formed in happier hours; as well as to many others, to whom it is not necessary to allude; for each may recognize its adaptation to some want.

If the writing is to be preserved, a metallic paper can be used which renders the writing indelible, or an ordinary style and carbon paper may be used.

For those who write much, however, a frequent change of posture as has been indicated, will afford a most agreeable relief. To gain this, I have been in the habit of changing from a sitting to a standing position. The only objection to the latter is that, too long continued, it tends to the formation of varicose veins in the lower limbs.

Any form of desk that admits of a standing position will do; but for those who desire to economize room, or who have but little use for such a desk, one that folds is a convenience.

But among all the most important things to be considered in this connection, that which perhaps stands

FIG. XLII.

Gold Spectacles, of the kind known as "Slide Temples," with medium sized frames.

most prominent is the method of illumination. It would seem almost unnecessary to some, I presume, to say that the light supplied by nature,—pure, clear, non-dazzling sunlight—is the best of all lights; but the assertions of ignorant or designing persons who have given out that some modes of artificial illumination are better than this gift of nature, will account for the necessity of the remark. While it cannot be denied that some forms of artificial illumination are far superior to others, we must still return to the original fountain source for the best.

From time to time, articles are scattered broadcast by the public press, extolling this or that special kind of oil as superior to some rival oil or even to street gas, and I am often asked which kind should be used; or if all oils should be given up, and the gas used. After considerable examination into the subject, and numerous inquiries among those who also have had experience with such matters, I am of the opinion that we cannot in every case lay down the same law, for some persons see better by gas and others by oil light. With proper care, one can soon learn which kind of illumination suits best, and then follow out his desires; but I am satisfied that the common attempt to compel each one of a family to use oil for near lights, and especially at night, is a mistake. Kerosene oil has at times a

very marked effect on my own eyes; I have verified this statement too often not to be sure of it. Even though entirely unaware that kerosene is being consumed in a room, a few moments work by it, at near objects, will reveal the fact of its presence by rendering my eyes troublesome. This is due to an irritating and smarting sensation which, however, passes off after a few hours rest. A long continuance of close application by gas light has never developed such distress.

Those who find oil more agreeable to the eyes, but unpleasant on account of the greasiness which pervades the lamp, even though the latter does not leak, can make use of the colza oil, it being free from this objection.

But whatever the material, care is again required to secure the most perfect combustion. This is best attained by the burner now generally introduced and known as the Silber argand burner. We are all familiar with the fact that where gas is being rapidly consumed, or in large quantity, the air quickly becomes foul; hence a free ventilation should always be maintained, not only to secure the necessary air for properly ærating the blood but to secure the best illumination. The same holds true when oil is being consumed, though we may be less conscious of it, and we should see that ventilation is not neglected.

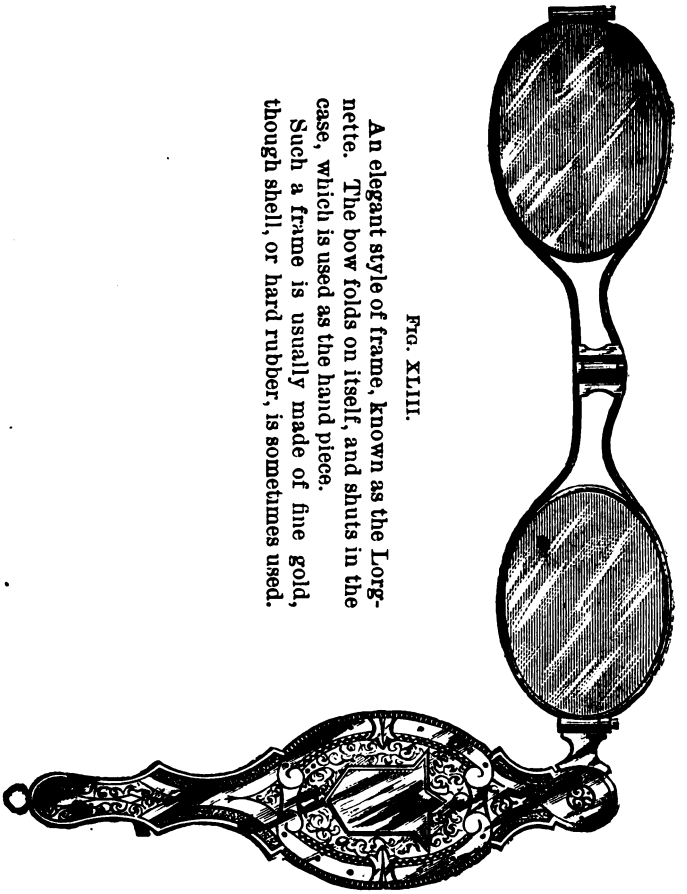


FIG. XLIII.

An elegant style of frame, known as the Lorgnette. The bow folds on itself, and shuts in the case, which is used as the hand piece.

Such a frame is usually made of fine gold, though shell, or hard rubber, is sometimes used.

The proper kind of lamp may also be important. Without going far into the subject, it may suffice to say that a lamp with a steady flame is essential, and is all the better if it have a good shade. That which is known as the student's lamp, complies with most of the essential conditions.

As usually hung over the head, the gas chandelier is not a fit light by which to read or study. Neither is any ordinary light placed at that distance. There is, perhaps, less harm done by too strong light than by too weak; with a little care there is usually no necessity for either.

TEST TYPES;

FOR TESTING THE VISION, IN THE SELECTION OF SPECTACLES. *

(No. 1 Jaeger.)

The Beauchamp Tower, a portion of the Tower of London, and a monument of ancient times and customs, is built on the bank of the river Thames, and stands on the brow of the eminence called Tower Hill, the spot where so many persons of distinguished character suffered death at the hands of the executioner. Judging from the position of the Tower, it seems probable that it was intended to defend the approach, by water, to the famous Metropolis of the British Empire. It has been confidently asserted that the Tower owes its origin to the Romans, yet, though there are many circumstances which appear to uphold the truth of this supposition, we must not take it for granted without examining the probabilities. Mr. Burton, in his history of the Tower, mentions that it is affirmed that the Tower was built about the time of Constantine the Great; it is also stated, that it was the treasury and mint of the Romans. The grounds given by Dr. Milles for this assertion are that in laying foundations for a new ordnance office, in 1777, the workmen discovered an ingot of silver bearing the impression of Roman characters, and also several gold coins, etc. Judging from these circumstances, and also from the naturally favorable position of the eminence on which it now stands, it seems probable that the Romans had some kind of fortress on the site of the present building, though there is no satisfactory ground for supposing that any building of importance existed here before the time of William the Conqueror, by whose command the White Tower was built, under the superintendence of Gundulph, Bishop of Rochester; and several important fortifications were added during the time of William's two sons, William Rufus and Henry I. Since its erection, the Tower has been used both as a Royal residence and State Prison, and if we consider it in either of these characters, it is full of interesting recollections to a contemplative mind. Stephen is the first monarch mentioned as residing in the Tower, he having kept his Court here during his troublesome wars with the Empress Matilda.

(No. 2 Jaeger.)
(No. 1 Snellen.)

About the year 1180, the Tower was surrounded by a moat, by Longchamp, Bishop of Ely, who was left in charge by Richard I, during his expedition to the Holy Land. King John frequently kept his Court at the Tower, and made many additions to the different fortifications; in 1215, the Barons besieged the Tower, and John was forced to make many concessions, amongst others the signing of Magna Charta. For some time after the death of John, his son was constantly employed in repairing the injuries sustained by the Tower during the turbulent reign of his father. It was probably during his reign that the tower was built which contains the antiquities enumerated in this book; he also began an additional line of fortifications, but was unable to complete his designs at this time, in consequence of the foundations giving way and the whole of the work being destroyed. This accident took place a second time, in 1241. Henry appears to have made the Tower his chief residence; it was there that he was compelled to subscribe to the conditions imposed by the Earl of Leicester and his traitorous associates. On the accession of Edward I, he considerably improved the fortifications of the Tower, by completing what his father began, and erecting several strong outworks as a defence to the principal entrance. The Tower does not

* Books of Test-Types, in several languages, with large cards to hang on the wall, may be obtained of any medical book-seller. Snellen's collection is one of the best.

(No. 4 Jaeger.)

appear to have been much used as a Royal residence during his reign, but to have derived its chief importance from its character of a State prison, to which purpose it was chiefly appropriated throughout the active career of this monarch. Of the Jews who were apprehended in 1278, on suspicion of clipping and adulterating the coin of the realm, no less than 600 were, at one time, confined in the Tower. In 1330, the infamous Mortimer was conveyed a prisoner to the Tower, and from thence to the gallows, by the command of Edward III. Though it is impossible, in this small book, to enumerate all the eventful scenes enacted in this fortress, yet, before we close this notice, we may mention that in 1509, Henry VIII brought his wife, Catherine of Arragon, to the Tower, after her coronation; and, in 1530, being tired of Catherine, he brought to the same place a younger

(No. 5 Jaeger.)
(No. 3 Snellen.)

and fairer bride, who was also destined, very shortly, to give way to a rival, and to suffer death amidst the scenes which had witnessed her former splendor. During the reign of Mary, the Tower was the scene of the imprisonment and death of her innocent rival, Lady Jane Grey, who was executed on the Tower Green in 1554. After the death of Mary, the Tower was very seldom used as a Royal residence; the usual procession from thence to Westminster was abandoned on the accession of James II, on account of the attendant expenses; nor have any of our Sovereigns since that period made the Tower their place of abode.

No. 10.

E C H D L U T O F S

No. 12.

F O L U E D S T C H

No. 15.

L S E O F D T H U C

NOT FOR LOAN

20 Feet.

U F D T C L S E

30 Feet.

C H O F D

MAU

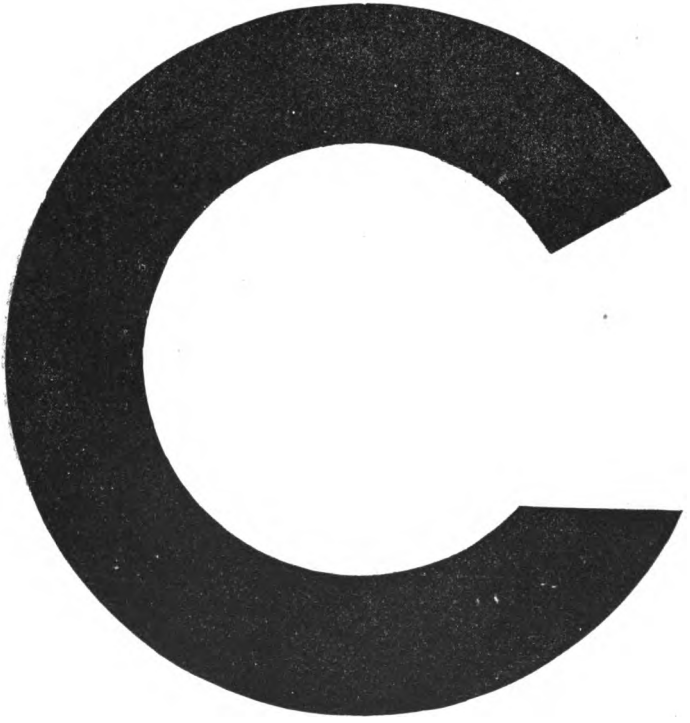
40 Feet.

D F S E

50 Feet.

O T D

70 Feet.

100 Feet.

200 Feet.